THE BIRDSEED BOOM | CATCH THE WAVES OF SPRING MIGRATION | A LEGENDARY QUEST

Audubon

SPRING 2023

ON YOUR MARK

The race to halt the perplexing decline of the American Kestrel

This spot of green dye helps scientists keep tabs on the clever falcon.

VISIT…

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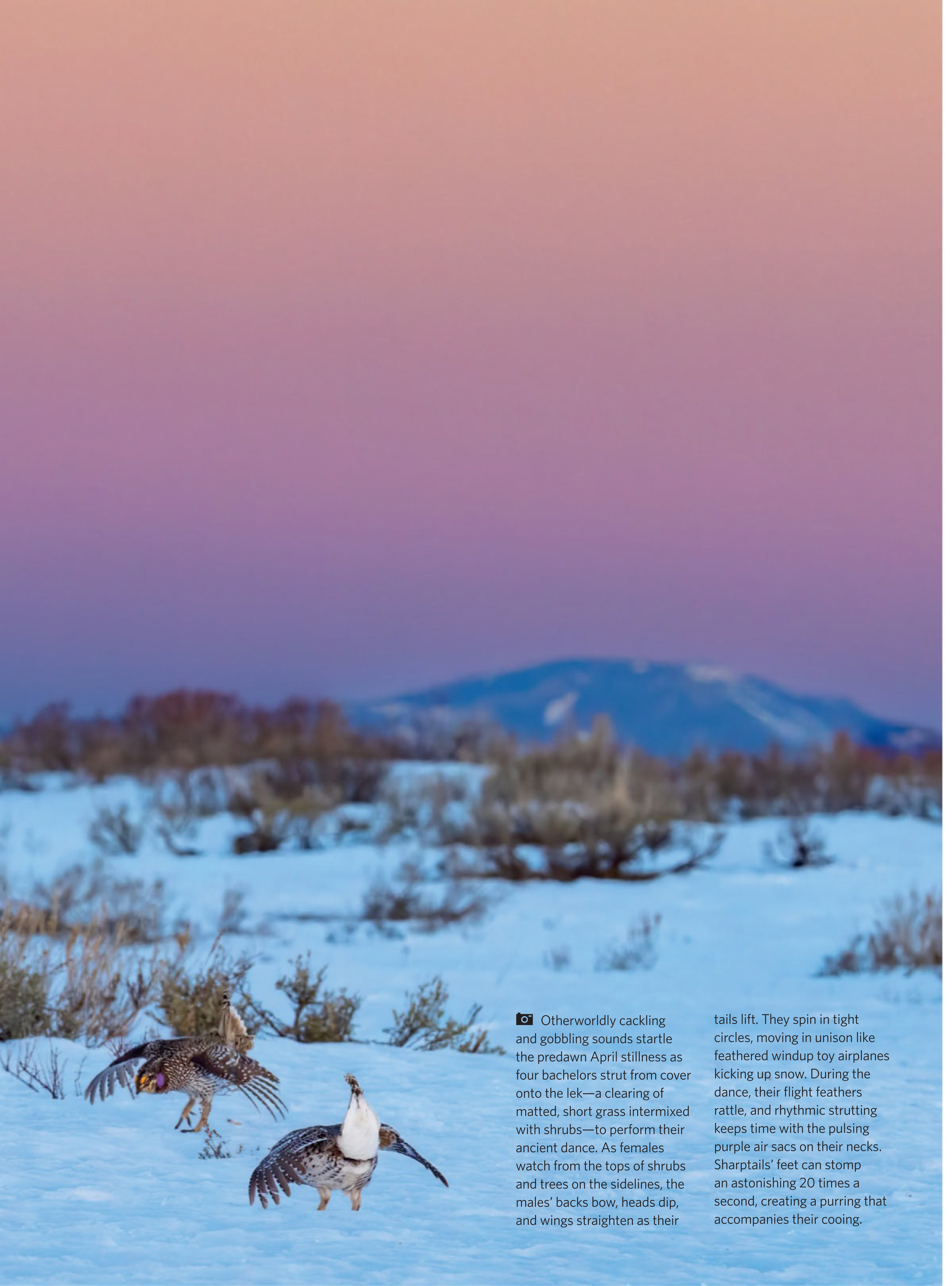
A Dancer’s Stage

The first time wildlife photographer Noppadol Paothong trekked to see Columbian Sharp-tailed Grouse perform their spring courtship rite at a remote lek in southern Wyoming’s mountains, it was blizzarding. With heavy gear on his back, he fell to his waist in snow every few steps, but with the help of a Wyoming Game and Fish Department biologist, Paothong finally made it to the nearly 8,000-foot-elevation site. They set up in a blind and hid for two hours until near ready to give up. Then, the sky cleared, and 20 birds came to dance atop seven feet of snow. “It was one of the most memorable moments in my photography experience,” he recalls. For the past dozen years, with the same determination as the birds, he’s returned in spring—making it his quest to capture the spirit of this enigmatic subspecies.

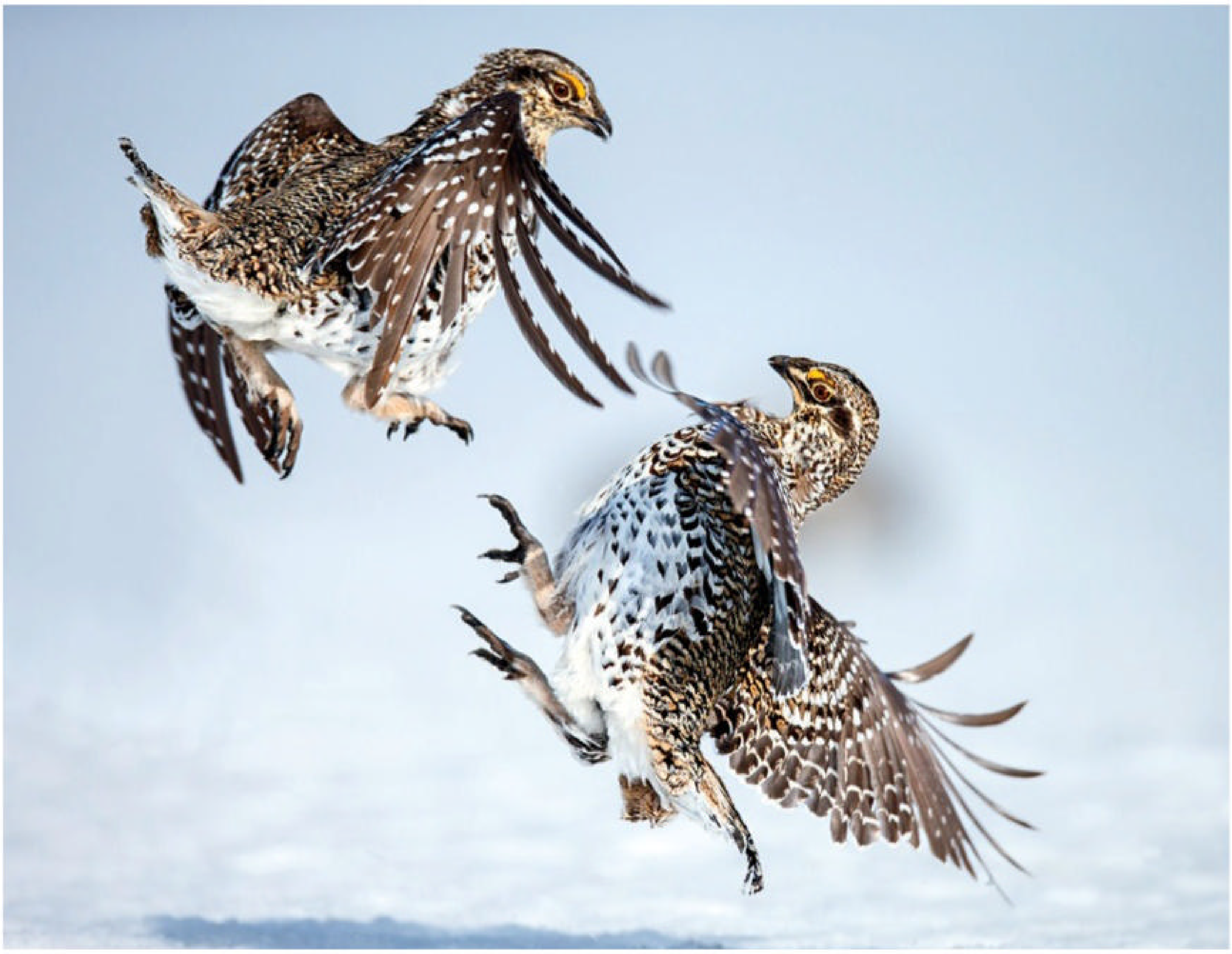
PHOTOGRAPHY BY NOPPADOL PAOTHONG

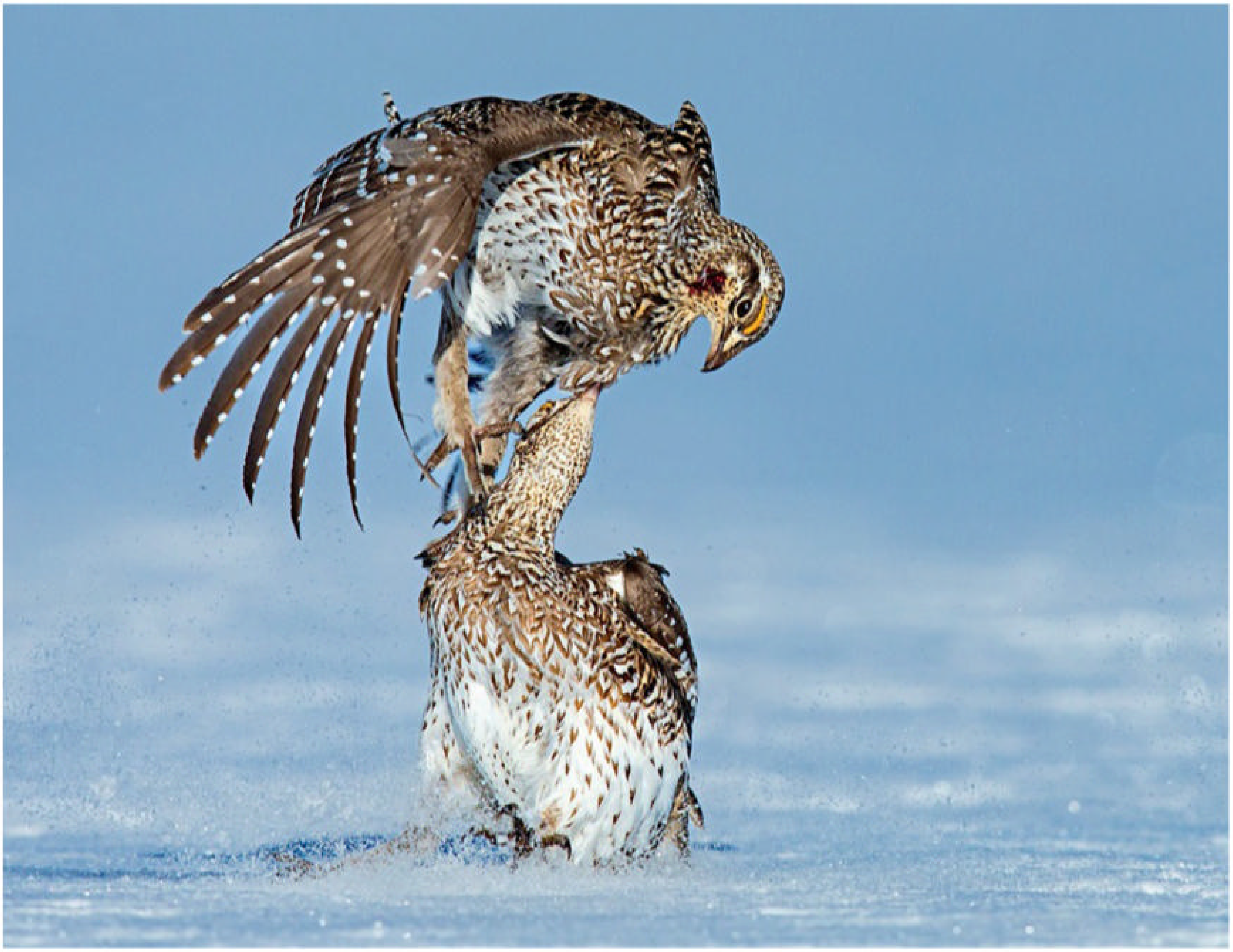
Text by Benjamin Alva Polley

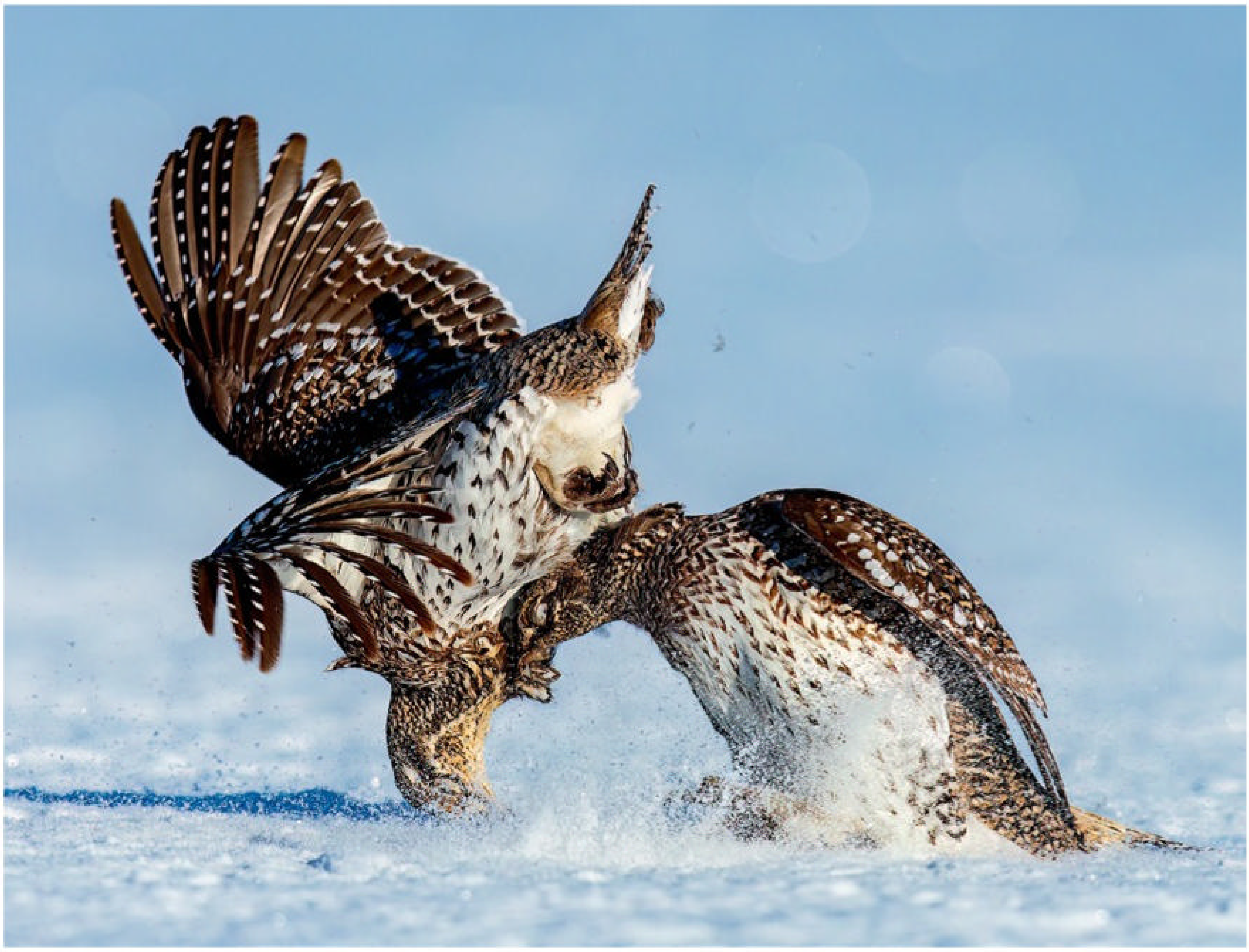


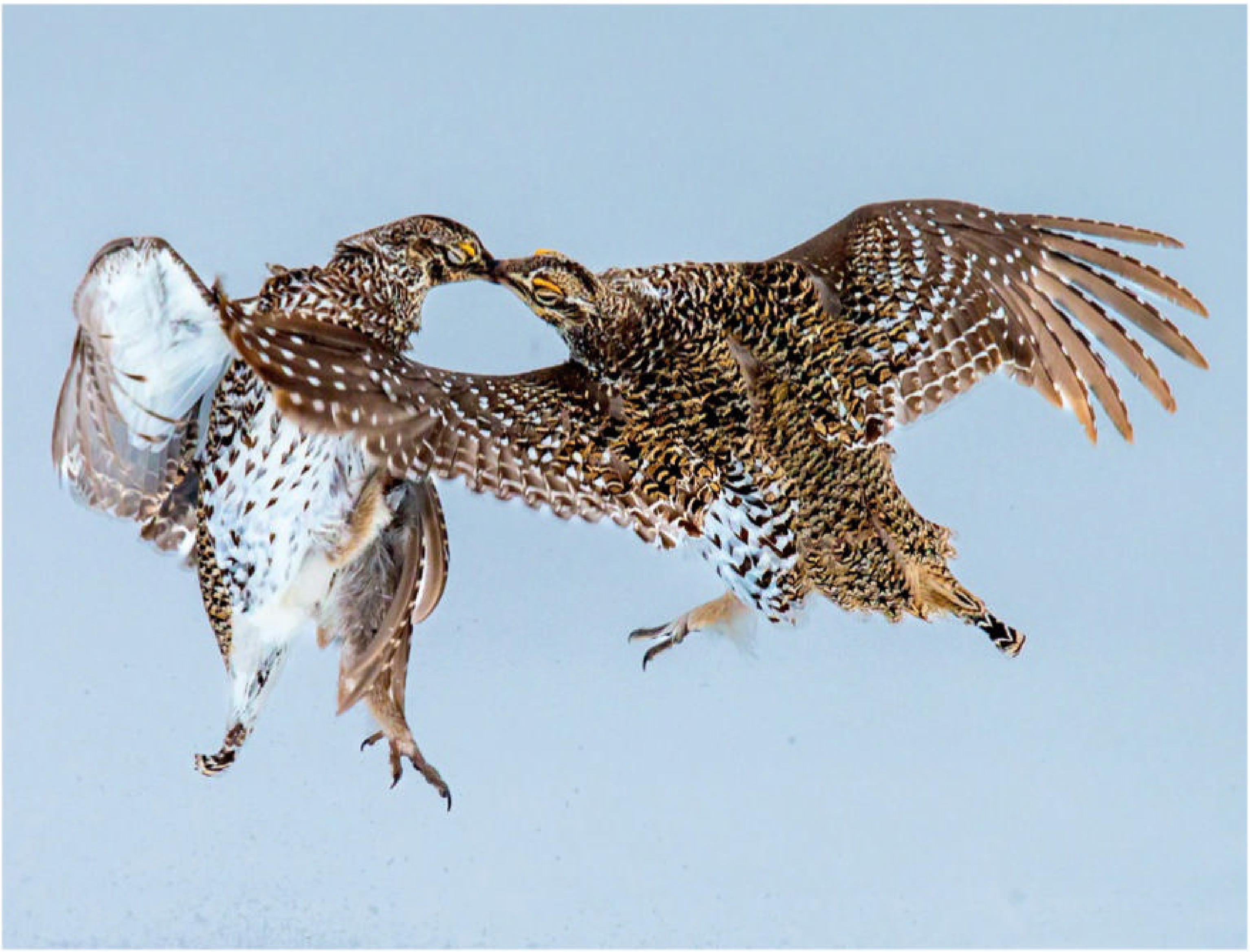
Otherworldly cackling and gobbling sounds startle the predawn April stillness as four bachelors strut from cover onto the lek—a clearing of matted, short grass intermixed with shrubs—to perform their ancient dance. As females watch from the tops of shrubs and trees on the sidelines, the males' backs bow, heads dip, and wings straighten as their tails lift. They spin in tight circles, moving in unison like feathered windup toy airplanes kicking up snow. During the dance, their flight feathers rattle, and rhythmic strutting keeps time with the pulsing purple air sacs on their necks. Sharptails' feet can stomp an astonishing 20 times a second, creating a purring that accompanies their cooing.

The sharptails' dance isn't always harmonious. As the dominant male seeks to maintain the lek center, nearby birds square off and spar several feet in the air to gain an advantage, chest-bumping, smacking, clawing, and pecking their rival. Staring contests are common. The congregation usually occurs from March to May, with females arriving in April to pick the male with the most robust stamina. The stakes are high: It's often winner takes all. After breeding, females don't go far to nest. "This elevation zone provides the perfect diversity of habitat types to cover their seasonal needs within a fairly small area," says Wyoming Game and Fish biologist Philip Damm.

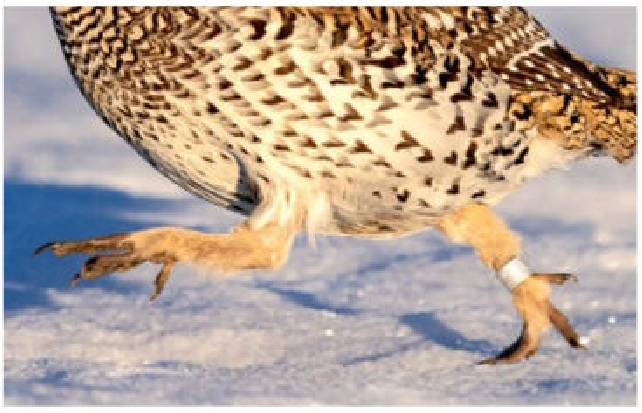




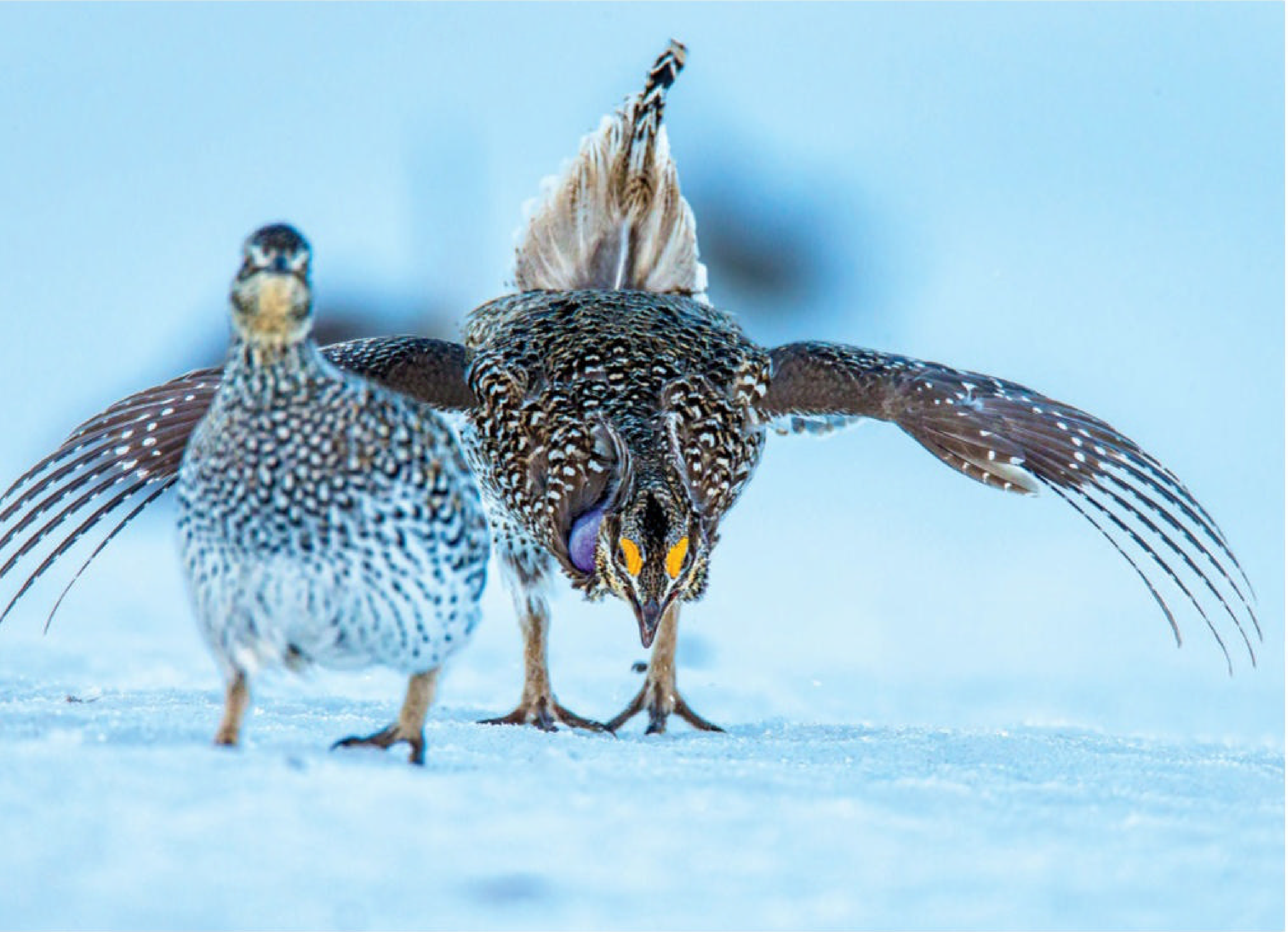




📷 Bundled head to foot, Paothong sets up in a blind well before first light to avoid disturbing the millennia-old display. Photographing the birds' erratic midair clashes is extremely challenging. These moments may last only a second, and the birds are often facing, fighting, and landing at different angles. Shots like these took years for him to successfully capture. Improving camera technology—which can shoot well in low light and focus on fast-moving animals—helped, but so did Paothong's growing familiarity with the spectacle. He developed a sense of when combat would begin: "Timing is everything to catch fighting shots."



Sharptails once ranged from Alaska to California, Oklahoma, and Quebec, but a myriad of threats have shrunk their habitat. The species has disappeared from eight Midwestern and Western states, while populations remain robust enough to hunt in others. Biologists monitor leks to gauge the health of six sharptail subspecies—and, by extension, that of the grassland and mixed shrubland they need. Leg bands (left), radio collar data, and DNA testing help biologists evaluate the birds' habitat selection and survival, offering clues to their lives and the best strategies for protecting them on the landscape.



The smallest of six subspecies, both male (left) and female (above, foreground) Columbian Sharp-tailed Grouse prefer higher elevations and are usually darker in color. While Wyoming designates the bird as a species of greatest conservation need, biologists are seeing populations increase at the state's southern leks (right), where intact or restored habitats abound on both public and private lands, thanks to rancher conservation efforts. Also a boon: The birds' diet of berries, forbs, insects, and seeds is highly adaptable, given enough habitat. University of Wyoming ecologist Jonathan Lautenbach is hopeful sharptails will find spaces to thrive in the long term—especially because "hunters and birders both can appreciate them," he says.

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Conundrum The Mysterious Decline of the American Kestrel

Populations of these colorful falcons have been shrinking for decades. Cutting-edge technology could finally help pinpoint where the birds are running into trouble—and why.

By Jillian Mock/Photography by Karine Aigner

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Journey Travel in the Time of Climate Crisis

As higher temperatures spur more hurricanes, droughts, and wildfires, now is the time to consider how tourism can help places rebound.

By Rachel Nuwer/Photography by Erika P. Rodríguez

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Enterprise Business Is Blooming

Birds aren't the only ones flocking to feeders. For the birdseed industry, the pandemic had a silver lining: lots of new customers finding joy in attracting avian visitors.

By Kevin Dupzyk/Photography by Greg Latza

Cover: An American Kestrel, identifiable by a daub of nontoxic dye. Photo by Karine Aigner

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Dispatch In Search of Auwo

Scientists hadn't seen the elusive Black-naped Pheasant Pigeon in more than a century. Last year, a determined team went on a mission to find one.

By Jason Gregg/Photography by John C. Mittermeier

PHOTOS CLOCKWISE FROM TOP RIGHT: GREG LATZA; JOHN C. MITTERMEIER; ERIKA P. RODRÍGUEZ; KARINE AIGNER

8 Inbox

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Our bold new strategic vision positions the organization for even greater impact. *By Elizabeth Gray*

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The rising toll from a deadly avian flu; why birders make ideal subjects for brain science; a historic rescue from surging seas; the moment of truth for America's imperiled sagebrush habitat.

48 Field Guide
Appreciate the artistry of nests and, while you're at it, read the map they provide to their makers' world. Are birds raising chicks in your A/C? Here's what to do. And this wave theory of migration will snap your spring birding into focus.

56 The Aviary
What do 50,000 birds look like? Data artist Jer Thorp's stunning visualization shows every individual counted on a single Brooklyn day.

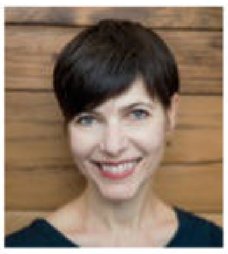
PHOTOS CLOCKWISE FROM TOP RIGHT: MIKE FERNANDEZ/AUDUBON; FENG YU/ALAMY; ASHLEY L. CONTI; RICK DEREVAN/AUDUBON PHOTOGRAPHY AWARDS

EDITOR'S NOTE

Lost and Found

Going in search of unfamiliar birds can be thrilling, but so can discovering the ones there all along.

BY JENNIFER BOGO, VICE PRESIDENT, CONTENT



Doka's delight was so palpable that our hearts soared right along with his.

When we first watched the video of biologist Doka Nason seeing a camera-trap image of a bird—*the* bird he and a team had just spent a month crisscrossing Papua New Guinea's steep terrain and dense tropical forests to confirm still existed—we were enthralled. His delight was so palpable, so utterly spontaneous and emphatic, that our hearts soared right along with his.

We loved that feeling and wanted to share it. So with the team's permission, we did some strategic editing (there were euphoric expletives) and published the video when we broke the news of their find online. "In Search of Auwo" (page 42) offers an in-depth account of the team's expedition.

The thrill of going on a quest to experience something unfamiliar is a feeling that resonates with many birders. It's why we so often travel to far-flung places in pursuit of new-to-us species. Although the goals (not to mention lodging) featured in "Travel in the Time of Climate Crisis" (page 28) are very different, that narrative also recognizes the value of expanding one's horizons. Both stories address an ethical dilemma for adventure seekers: grappling with how such travel can benefit, rather than harm, local communities—particularly in the face of mounting economic and environmental pressures.

As he ponders this question in "In Search of Auwo," Jason Gregg asks another: "What does it mean for a species to be lost?" The Black-naped Pheasant Pigeon, or Auwo, had been missing from the scientific record. But we can look elsewhere in the magazine for another answer. As we learn in "The Mysterious Decline of the American Kestrel" (page 20), a bird can be the most abundant falcon in North America, nesting on the edge of housing developments, and still have disappeared from the skies by the millions—in effect, becoming absent to countless birders, hawk watchers, and nest-box monitors. The scientists in that story are on a quest to piece together the puzzle of the kestrel's decline in hopes of slowing the concerning trend.

In this issue we also see that species do not need to be lost to be found. Especially during the pandemic, multitudes of people discovered the birdlife that had been in plain view all along, giving a boost to the birdseed industry and spurring entrepreneurs ("Business Is Blooming," page 34). In the process, they found for themselves the elation that comes from sharing a totally ordinary moment in the otherwise extraordinary life of a bird.

Western Fence Lizard

Happy Herping! This spring, consider expanding your ID skills beyond birds—by looking down, not up. Lizards, snakes, turtles, and their cold-blooded brethren are likewise all around us to observe and appreciate. Perhaps unsurprisingly, many birders already share an interest in seeking out reptiles and amphibians, known as field herpetology, or herping for short, while enjoying nature. Learn how you can pick up this pursuit, best practices from seasoned veterans, and tips for sharpening your herping sixth sense at **audubon.org/herping**.

Send letters to audubonmagazine@audubon.org.

RE: "Flight of the Spoonbills"

How could anyone look into the eyes of the Roseate Spoonbill on your Winter cover and not listen to its message? May this finally be the year we act on behalf of spoonbills and all other birds. I'm keeping this beautiful photo on my desk so I can listen and hear clearly. Thank you for all your work.

PAT THOMAS

RE: "Songs from Silence"

A big shout-out to Lang Elliott! This news is so exciting. I have bilateral high-frequency hearing loss. I did not realize how much it affected my birdwatching until a friend said to me, "Ah, Downy Woodpeckers courting." I heard nothing. He pointed to their location. Nothing. Because my hearing loss is related to bone conduction, occluding headphones, like the kind Lang has developed, would probably be well suited to my needs.

AMY TAN

RE: Field Guide

If we want things to stay the same, things must change, including air travel. Please don't encourage yet more flights for "escape," "get-aways," and "inspiration," each of which pumps tons of carbon dioxide into the atmosphere. We're harming the birds we are flying to look at. And, no, buying carbon credits does nothing to remove that carbon—the damage is done. Your articles on at-home birding, bird feeding, and heated baths were right on point.

RANDOLPH HUDSON

May this finally be the year we act on behalf of spoonbills and all birds.

RE: "Bitter Harvest"

Thanks for the article "Bitter Harvest," which is about the weed killer dicamba and its impact on bird habitat. I found it very informative. However, I think you forgot the coda: "Buy organic!"

SAL LEVINSON

RE: "An Ode to Weird Duck Time"

Thanks for Rosemary Mosco's "An Ode to Weird Duck Time"! I love her science writings and illustrations. After discovering the winter ducks of Boston Harbor years ago, I look forward to every fall and another season of enjoying these birds in their striking plumage. If the wind and waves are calm enough, I can sometimes hear from shore the cooing of Common Eiders: a sweet, funny little noise that sounds a bit like surprised approval.

DEBORAH BAKER

Night Light A new study reveals that light pollution is causing our night skies to get brighter even faster than researchers previously thought, drowning out more stars with each passing year. Learn what this means for humans and animals alike at **audubon.org/skylight**.

PHOTOS CLOCKWISE FROM TOP LEFT: CREEPING THINGS/ALAMY; ANDREA MORALES; LIAN LAW/NPS; ROSEATE SPOONBILL, MAC STONE

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Sandhill Cranes.
Photo: Mary Lundberg/Audubon Photography Awards

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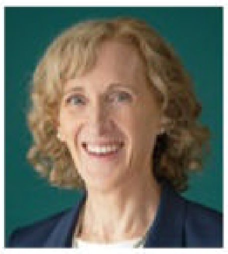
A Road Map for the Future

Our bold strategic plan will achieve new levels of impact for birds, people, and the planet.

BY ELIZABETH GRAY, CHIEF EXECUTIVE OFFICER



PHOTOS FROM TOP: LUKE FRANKE/AUDUBON; RICK DEREVAN/AUDUBON PHOTOGRAPHY AWARDS

THIS WILL BE A HISTORIC YEAR: 2023 will be remembered in Audubon's story as the year we launched a new strategic direction, fully entered the global conservation arena, and positioned ourselves as an important conservation innovator for the decades ahead. I will cover each of these pivotal milestones in columns throughout the coming year.

As this issue goes to press, the Audubon Board of Directors has just endorsed a strategic plan that reflects the knowledge, passion, and courage of our staff, board, members, and network of chapters. Thank you to everyone who voiced their hopes for the future of birds and the places they need to thrive.

Our new strategic vision brings forward the importance of birds in the lives of people. Birds need the same healthy environments and conditions that we need to thrive. They are sentinels for healthy lands, waters, and communities: When birds are in trouble, we are in trouble.

The science is clear. We are approaching a biodiversity crisis and have a 10-year window to change course. Birds have the ability to unite people across political and ideological divides. Now is the time to harness this ability and push for solutions that lessen the severity and impacts of climate change. It is time to invite all bird lovers under our tent to create an inclusive movement that engages the conservationists of today and tomorrow. We will scale our work to span the Western Hemisphere and protect birds over their entire life cycles and migration routes. These efforts will be woven throughout everything we do moving forward.

I recently joined leaders from organizations across the country at the White House for a conversation on climate and environmental justice. This administration's vision for tackling climate change in a just and equitable way is inspirational. I was also heartened to hear many connections to our emerging strategic plan in areas like climate-smart agriculture and clean energy permitting. Vice President Harris stressed the importance of membership organizations like Audubon influencing decision makers and ensuring that funds are focused on achieving transformative change in the places that need it most.

We are poised to meet the urgency of the moment before us. This next chapter is built on experience, expertise, and hope. Every day I am reminded that the greatest hope comes from birds themselves. We know they are resilient if we give them a chance. Birds can spring back from the edge of extinction. They show us that we can make a difference when we put our minds to it.

I am thrilled to have such thoughtful partners—including you, our Audubon members—during this time of innovation and focus. I look forward to sharing more of our plans with you over the next few issues of the magazine.

> I am thrilled to have such thoughtful partners—including you—during this time of innovation and focus.

Some populations of Sandhill Cranes migrate in spring and fall, stopping at wetlands along the way to feed and rest.

FIELD NOTES

CONTAGION

Bird Flu Blazes On

Facing an outbreak that is unusually deadly for wild birds and is spreading to more mammals, scientists worry about when—or if—it will end.

BY SAIMA MAY SIDIK

IN LATE 2021, TUFTS UNIVERSITY virologist Wendy Puryear began to worry. The avian flu virus was behaving oddly. It usually passes through wild birds with little harm. But in Europe, a highly pathogenic strain known as H5N1 was killing a range of avian species and infecting mammals like otters and foxes.

Then it hopped across the Atlantic. Carried long distances by migrating waterfowl, gulls, and shorebirds, within months the virus found almost every corner of North America—and eventually South America—until the situation reached "whole new levels of crazy," Puryear says.

By now, USDA's National Wildlife Disease Program has detected the virus in nearly 150 avian species, from owls to pelicans to geese, and recorded thousands of dead birds, says program lead Julianna Lenoch. Meanwhile, H5N1 hit North America's farms. More than 55 million poultry have died—some from flu and others culled to contain it—at a cost of billions of dollars. At grocery stores, egg prices skyrocketed.

Despite surging and cresting in the past year, the now-global strain is showing no signs of burning out. Birds are facing their own pandemic, with unknown long-term consequences for avian health. Public health agencies are also monitoring for human infections. While rare, people can contract bird flu through close contact with infected birds or contaminated surfaces. What's more, there's a low but real risk the strain could mutate to enable people to pass the virus to others, a scenario that's caused past human pandemics.

Although it snowballed recently, today's situation has been brewing since 1996 when a garden-variety avian influenza acquired mutations on a farm that made it lethal to poultry. Over time, the virus appeared in Asia, Europe, and Africa, with an outbreak hitting North America in 2014 before fizzling. Experts think further mutations may be behind its recent ability to cause more severe disease in wild birds and infect more birds and some mammals.

To keep tabs on H5N1, USDA and other agencies are collecting samples from tens of thousands of wild birds—mostly dabbling ducks, which transmit the virus when they congregate (usually without getting ill). As birds return from their migration journeys in spring, scientists will be looking at whether the virus has changed genetically over the winter in ways that make it more or less dangerous, and whether it affects bird behavior during the breeding season.

While determining the flu's long-term effects will take more time and surveys, researchers are especially concerned about its impact on vulnerable avian populations, including some colonial waterbirds, long-lived seabirds, and birds of prey. In June, for example, almost 1,500 Caspian Terns died on Lake Michigan islands—about 60 percent of Wisconsin's population, including many breeding adults. Such losses, says Timm Harder, a veterinary virologist at Germany's National Reference Laboratory for Avian Influenza, could leave "a deep scar" on future generations. Bald Eagles, which can get sick after consuming infected waterfowl, also face challenges. A recent study reported an unusually poor eagle nesting season in avian flu hotspots in Georgia and Florida. The authors warned the disease may pose an "impending threat" to a species that conservationists spent decades bringing back from near extinction.

> Researchers are especially concerned about the flu's impact on vulnerable avian populations.

📷 **Wearing protective gear, rangers clear seabird flu victims at an important U.K. breeding colony in 2022. Authorities advise the public to avoid touching live or dead birds.**

It's a disheartening situation for bird lovers. While songbirds are mostly unaffected so far, some authorities have urged taking feeders down during local outbreaks, so birds don't gather and risk getting the flu. Audubon advises removing feeders if at least one local wildlife agency calls for doing so and regularly cleaning any feeders or baths in use. Also: Don't touch live or dead birds.

Broader efforts to rein in the virus also face uncertainty. Wild birds pass it to poultry and vice versa, and even the best measures to avoid such intermingling aren't foolproof. Rodents, farm equipment, or even the wind may move the virus around. Given this outbreak's staying power, governments and experts are debating the use of vaccines. But giving doses to billions of farmed birds might not be feasible, Harder says, and vaccinating wild birds through bait they consume is even harder. While inoculations could target high-risk animals such as free-range chickens that interact with wild birds, incomplete measures also risk speeding the rise of new variants, says University of Missouri virologist Henry Wan.

These considerations may feel familiar to a world still reeling from COVID-19. At press time, H5N1 was appearing more widely in mammals, including wild bears and sea lions and farmed mink. Experts called for more urgent measures, such as better biosecurity on farms and improved global cooperation, to ensure that bird flu won't trigger another major public health crisis. Ⓐ

PHOTO: OWEN HUMPHREYS/PA IMAGES VIA GETTY. ILLUSTRATION: FELIX SOCKWELL

The Birding Brain Boost

Neuroscientists puzzling over how human memory, learning, and decision-making function turn to birdwatchers to connect the dots.

BY JOANNA THOMPSON

MOST DOCTORS IN TRAINING don't begin a new semester expecting to learn about birds. But after her first year studying at Harvard Medical School, Lynn Hur was hooked. "It's become one of my favorite activities," she says.

Hur came to the hobby courtesy of associate professor Rose H. Goldman, who incorporates bird identification into her Practice of Medicine class to help sharpen students' clinical diagnostic skills. In lecture, for example, Goldman asks students to differentiate between a Great Egret and Snowy Egret by homing in on details such as size, beak shape, and foot color that distinguish the slender, white birds. Until classes went virtual during the pandemic, Goldman, an avid birder, also led students on birding outings.

At first blush, it might not seem like cardinals and carcinomas have anything in common. But Goldman believes the process of discerning similar birds isn't all that different from examining the subtleties of a patient's rash to determine whether to treat eczema or test for skin cancer. "I personally feel that my powers of observation and memory have really improved from doing birding. But I have no way to prove that," Goldman says.

With her unusual teaching strategy, Goldman is hitting on something that neuroscientists know well: Gaining deep expertise in a subject area can change your mental scaffolding, literally rewiring

SCAN: CAMPTOLOMA/SHUTTERSTOCK

ILLUSTRATIONS BY LUCY JONES

your brain. To better grasp this process, brain and memory researchers have long turned to birders (and occasionally med students) as a go-to group of test subjects—even in foundational cognitive research.

Breaking open that field guide could help uncover innate perception skills.

As recently as three decades ago, most neuroscientists theorized that humans' keen ability to distinguish between similar faces was somehow special. They even suspected our brains had a particular area dedicated to face processing. But when Isabel Gauthier, then a young cognitive neuroscientist at Yale University and now at Vanderbilt University, went looking for this fabled region in the late 1990s, she quickly discovered that this "face area" of the brain was actually several sectors involved in recognition.

By scanning brains of experienced birders using a recently invented functional MRI machine, she and colleagues found that these areas weren't dedicated to sorting facial information alone: A bird and a friendly face could activate the same brain regions. "Faces aren't special," Gauthier says. "They're a case of expertise." As it turns out, people can fine-tune their ability to distinguish among any similar-looking objects, from faces and cars to skin conditions and birds. All it takes is exposure and practice.

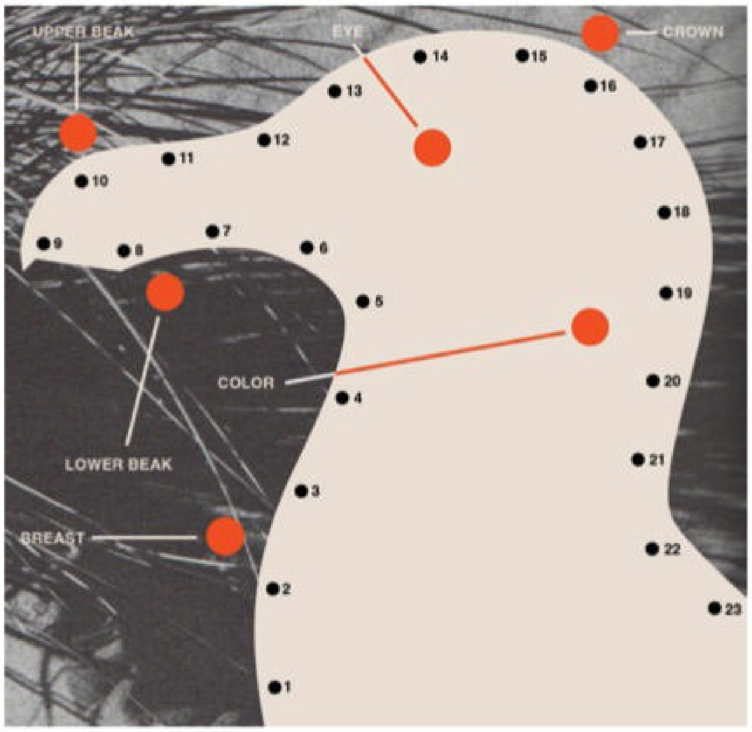
This observation helped open the door to new avenues of perception and cognition research—and birders continued to participate. According to Thomas Palmeri, another Vanderbilt University neuroscientist who has recruited volunteers through the American Ornithological Society and local Audubon chapters, birders make excellent subjects because it's easy to find enthusiasts with a wide range of skill levels, and they are more likely to participate in community science–style surveys.

In his work studying visual expertise and memory retrieval, Palmeri ran his subjects through a series of bird identification tests. He used the data to build computer models that simulate real-time decision-making processes in the human brain. What's useful, he says, is that all birds share the same broad set of features—feathers, beaks, two feet, two wings—but are still incredibly varied. To identify a specific warbler or hawk, a birder might spot and synthesize its markings, silhouette, shape, movements, and sounds in seconds. "It's not about just 'bird, bird, bird,'" Palmeri says. "It's identifying a specific species and even subspecies."

Developing this kind of perceptual expertise shifts the patterns of firing brain cells, or neurons, according to Gauthier's findings. The more a person learns and practices, the more often a signal moves between neurons, and the path becomes easier to traverse, like a well-trodden hiking trail. This phenomenon, called neuroplasticity, may enable experts to distinguish between objects more quickly, seeing them as a whole and ignoring distracting or superficial features, she says.

Glory Kim, a Harvard School of Dental Medicine student and another alum of Goldman's bird outings, recalls experiencing this rewiring firsthand. "At some point, when you see a bird, you automatically gather all these context clues and your brain just converges very fast on what it is," Kim says.

Over time, expertise can even change the structure of the brain itself. Parts of the cerebral cortex may become slightly thicker as a person's visual and auditory expertise deepens. This makes it easier for experts to add new information to their mental repertoire, says Erik Wing, a neuroscientist at Rotman Research Institute in Canada.



Wing, a birder himself, studies how these changes influence memory. In research published in 2022, Wing recruited birders of varying experience levels and asked them to identify images of both familiar and non-familiar birds. The results demonstrated that long-term knowledge of avian species helped people to more easily remember new birds. For example, an experienced Boston birder visiting San Francisco might be unfamiliar with local species at first. But thanks to their neural scaffolding, experts will have a relatively easier time learning, and may even retain knowledge better as they age, Wing says.

So, can medical students in Goldman's class improve their diagnostic skills by birding? Possibly—but the correlation isn't direct. "It's not like because a person is really good at birds, they're going to be better at cars," says Gauthier.

However, breaking open that field guide could help uncover innate skills in perception. For example, a person who has a knack for birding might also be gifted in a visual diagnostic field, like dermatology or radiology. And vice versa: Someone who naturally gravitates toward the visual side of medicine might be a sharp birder. Wing's research also suggests that developing the frameworks and tools for birding helps a person sharpen their focus in other areas. "If you get practice tuning your attention toward different features that are more diagnostic or less diagnostic," says Wing, "that is, I think, a valuable thing."

Whatever's at work in their brains, Harvard students Kim and Hur have continued to enjoy birding since Goldman's class. For both, it's become an indispensable outlet for dealing with medical school and pandemic stress. They've even begun sharing their hobby with classmates by coleading a student birdwatching club. And though she can't always escape into the woods, Hur tries to sneak in birding as much as she can. "I'm in a busy part of my medical education right now," she says. "But I do carry my binoculars in my backpack at all times." Ⓐ

The Big Lift

Naturalists are saving a historic building at Maine's Hog Island Audubon Camp by elevating it above rising floodwaters.

BY KATHRYN MILES

THE NARROWS SURROUNDING Maine's Hog Island have been populated with lobster boats and recreational craft for well over a century. But last autumn, a very different vessel appeared there: a 40-foot barge carrying several tons of timber, stone, and hydraulic equipment, all in service of an ambitious project to save one of Audubon's most historic structures, a building called the Queen Mary.

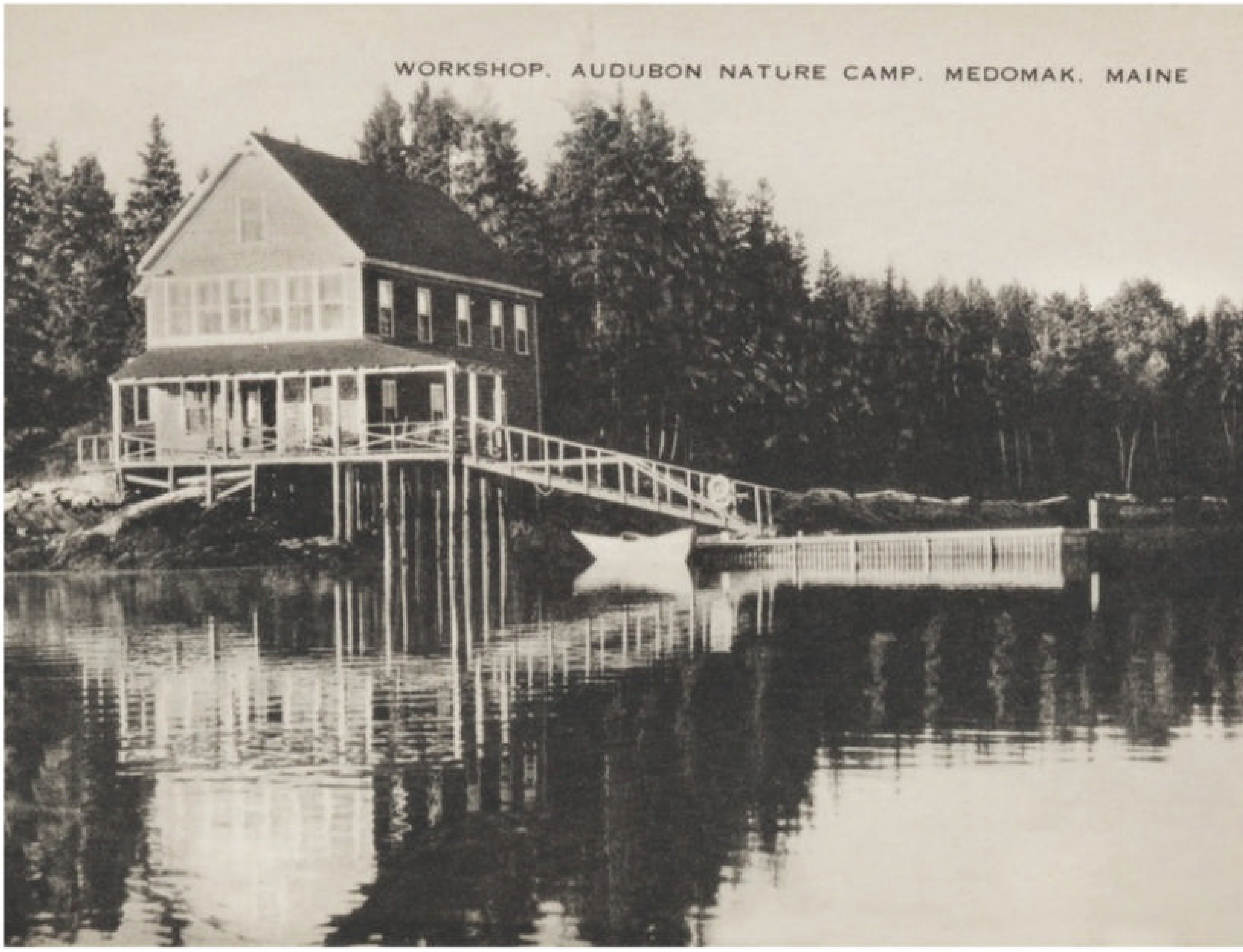
Like many of Maine's 142 coastal communities, Hog Island is confronting sea-level rise, projected to increase substantially in the coming years. Over the past few decades, winter storm surges have started flooding the Queen Mary up to its floor joists, damaging the building and impeding access. A few times water has even risen above the floor. The threat has raised tough questions for those who live and work here: Do they adapt to higher water, or do they abandon and retreat?

When it comes to maintaining what makes Hog Island special, says facilities manager Eric Snyder, there is only one option. "We can't build another structure like this," he says. "Preservation has to be key."

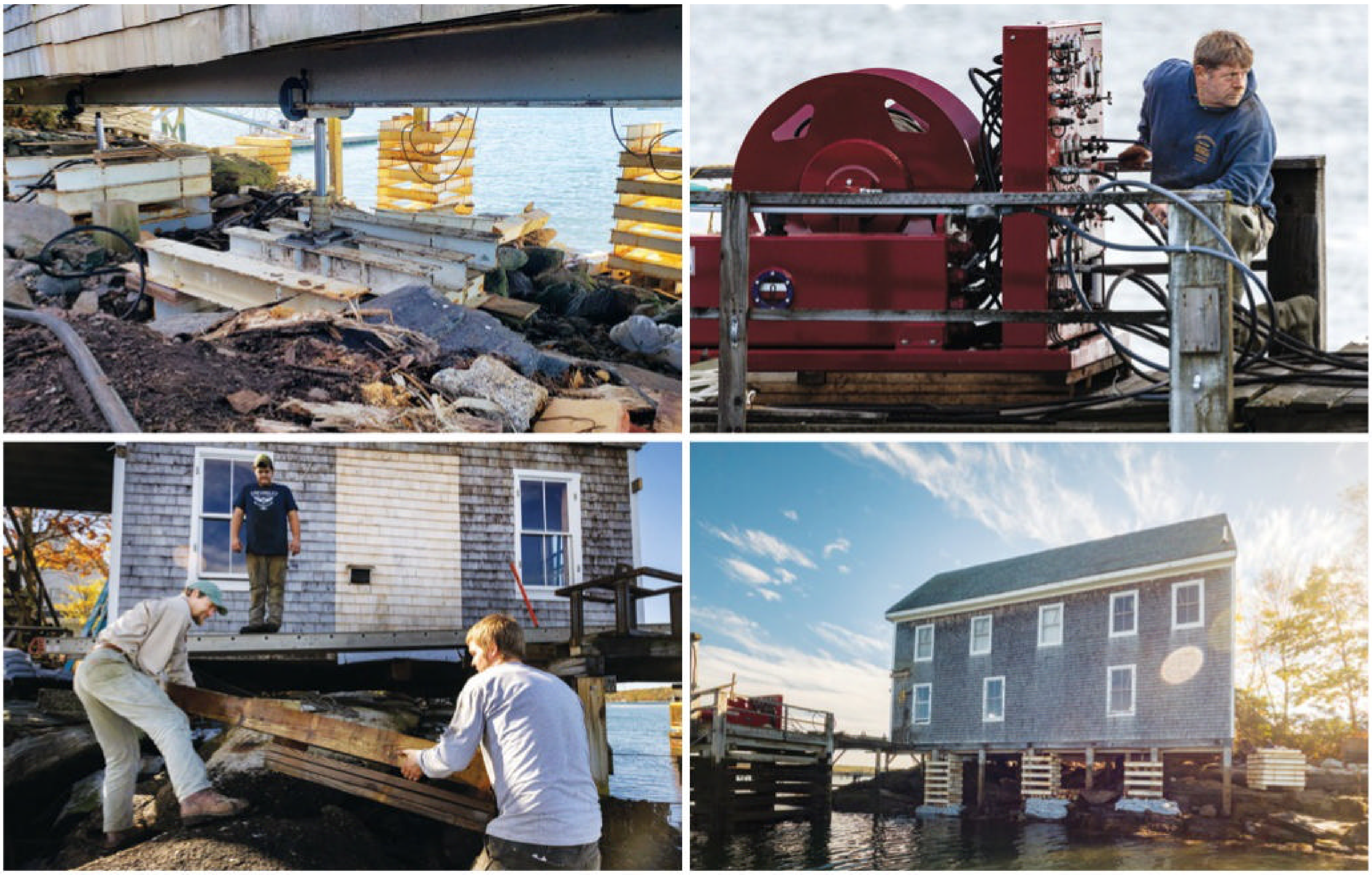
The Queen Mary was first erected in the mid-1800s as a shipping supply store, barely set back from the shoreline. Then in the early 1900s, when Maine became a vacation destination, it was turned into a resort. In the 1930s Hog Island's owners, the philanthropic Todd family, approached the National Association of Audubon Societies to conserve the property and establish a camp dedicated to nature study. In 1935 Audubon began leasing the island for a dollar annually. The following year, Hog Island Audubon Camp opened to guests.

Since then, thousands of adults and children have streamed through the building, which houses a scientific laboratory and sleeping lofts, for summertime science and nature studies. And here, one of ornithology's most ingenious conservation efforts was born. In the early 1970s, ornithologist Stephen Kress used Hog Island as the headquarters for Project Puffin. Testing experimental methods, he restored Atlantic Puffins to the southern Gulf of Maine by relocating chicks from a Canadian colony to the offshore island Eastern Egg Rock. Campers helped raise them by hand.

"Hog Island literally laid the groundwork for hundreds of subsequent efforts around the globe," says camp instructor Don Lyons, who is also the director of conservation science at Audubon's Seabird Institute. "It's proof that if you create a place where people come together and find inspiration, we can do great things."



Originally a shipping supply store, the Queen Mary (pictured here in the late 1930s) also served as a dance hall and casino before Hog Island Audubon Camp made it a scientific hub.



Clockwise from bottom left: Hog Island's Eric Snyder and Jewett Builders' Graham Frost installed bracing beneath the Queen Mary in October 2022. Later, hydraulic jacks (operated by Don Jewett) lifted the structure.

PHOTOS CLOCKWISE FROM TOP LEFT: ERIC SNYDER; ASHLEY L. CONTI (3); FRIENDS OF HOG ISLAND DIGITAL ARCHIVE

But that place is now under siege by the sea. The winter storm flooding that began in the 1970s has intensified over time and become regular. In 2020 erosion forced employees to relocate one of the island's main trails 15 feet inland. Inside the Queen Mary, staff added risers beneath cabinets containing a historic collection of bird skins. The specimens, dating to the 1800s, include rare and extinct species such as the Passenger Pigeon.

"We knew the water was going to keep getting higher and higher," Snyder says. "It was time to commit to really doing something."

After years of worried discussion, in March 2021 camp staff and members of the nonprofit Friends of Hog Island (FOHI) decided to lift the entire building above the floodwaters. Securing the necessary permits proved onerous. Raising the Queen Mary by several feet would knock the structure out of compliance with local zoning restrictions. Eventually, the town of Bremen amended its building and zoning requirements to let the project proceed.

"We hit roadblocks at every corner," Snyder says. "It really makes you wonder what difficulties coastal homeowners are encountering."

By comparison, the actual raising was a breeze. FOHI contacted Jewett Builders, which specializes in lifting and moving buildings. By the time they made a plan, Don Jewett was already booked more than a year in advance. "It's a good time to be in the building-lifting business," he says. "Sea-level rise has meant more business than small companies like ours can handle."

In fall 2022, Jewett arrived at Hog Island to raise the Queen Mary in a series of lifts. Over the course of several weeks, his team set up bracing beneath the building. Then they used hydraulic jacks to safely lift the three-story building in one motion. Once everything was set up, the process was so smooth that no one bothered to move the furniture and equipment inside, including a fishbowl and glass vase perched precariously on the edge of a filing cabinet. In all, Jewett and his crew raised the Queen Mary by three feet.

They finished just in time. The day after the equipment was removed from the island, a winter storm flooded the boathouse and would have flooded the Queen Mary, Snyder says. "But it stood high and dry on its new, strong foundation."

It's not known just how long the Queen Mary can stay flood-free at its new height. Maine's government expects at least 1.5 feet of sea-level rise in the next 25 years. However, that calculation assumes humanity will make significant cuts to carbon emissions in the meantime. Staff hope the lift will keep the building dry through those changes, at least, but the future of the Queen Mary and Hog Island's other historic buildings remains precarious. Will they survive another century?

That depends, Snyder says, on the actions of politicians, businesses, and ordinary people. "Are we going to follow the Paris Accord? Are we going to really commit to alternative energies?" Snyder says. "When it comes to sea-level rise, the answers to those questions are going to be measured in feet, not inches."

Last Best Hope

The window of opportunity to save the sagebrush ecosystem is rapidly closing.

BY ANDY MCGLASHEN

ADDED TOGETHER, THE SWATHS of sagebrush habitat that the West has lost since 2001 would cover half of Utah. This embattled ecosystem's decline is an old story, but new evidence of the scale and pace of its destruction has conservationists questioning how much longer it can function as habitat for more than 350 plant and animal species. A multi-agency study from 2022—the fullest health assessment to date for the largest biome in the contiguous United States—found that 1.3 million acres of sagebrush are vanishing each year. At that rate, the remaining healthy habitat will be gone around midcentury.

"The most recent science has shown us what a serious situation we're in," says Daly Edmunds, policy and outreach director for Audubon Rockies. "We're really at a critical point in determining what the West looks like."

The spicy scent of sagebrush once perfumed some 300 million acres, anchoring an intricate network of life. Creatures like Greater Sage-Grouse, Sagebrush Sparrow, pronghorn, and pygmy rabbit can't live without these fragrant shrubs. But today less than half the landscape's original vastness endures—a staggering loss driven, directly and indirectly, by human activity. Sage-grouse populations, an indicator of ecosystem integrity, have plummeted by 43 percent in just the past two decades.

During that period, invasive grasses, such as cheatgrass, and the immense, increasingly frequent wildfires they fuel combined to devour more habitat than any other factor, the study found. "But there are other threats that are catching up very quickly," says Shawn Espinosa, a Nevada Department of Wildlife biologist. Mining, energy production, conifers edging into open rangeland, overgrazing by cattle and feral horses, droughts exacerbated by climate change—together, these pressures are overwhelming the ecosystem.

Although the trends are alarming, experts remain warily optimistic. "The chance for us to stem that tide is probably as good as it's ever been," says Matt Cahill, The Nature Conservancy's Sagebrush Sea program director.

80%

DECLINE IN GREATER SAGE-GROUSE POPULATION SINCE 1965

43%

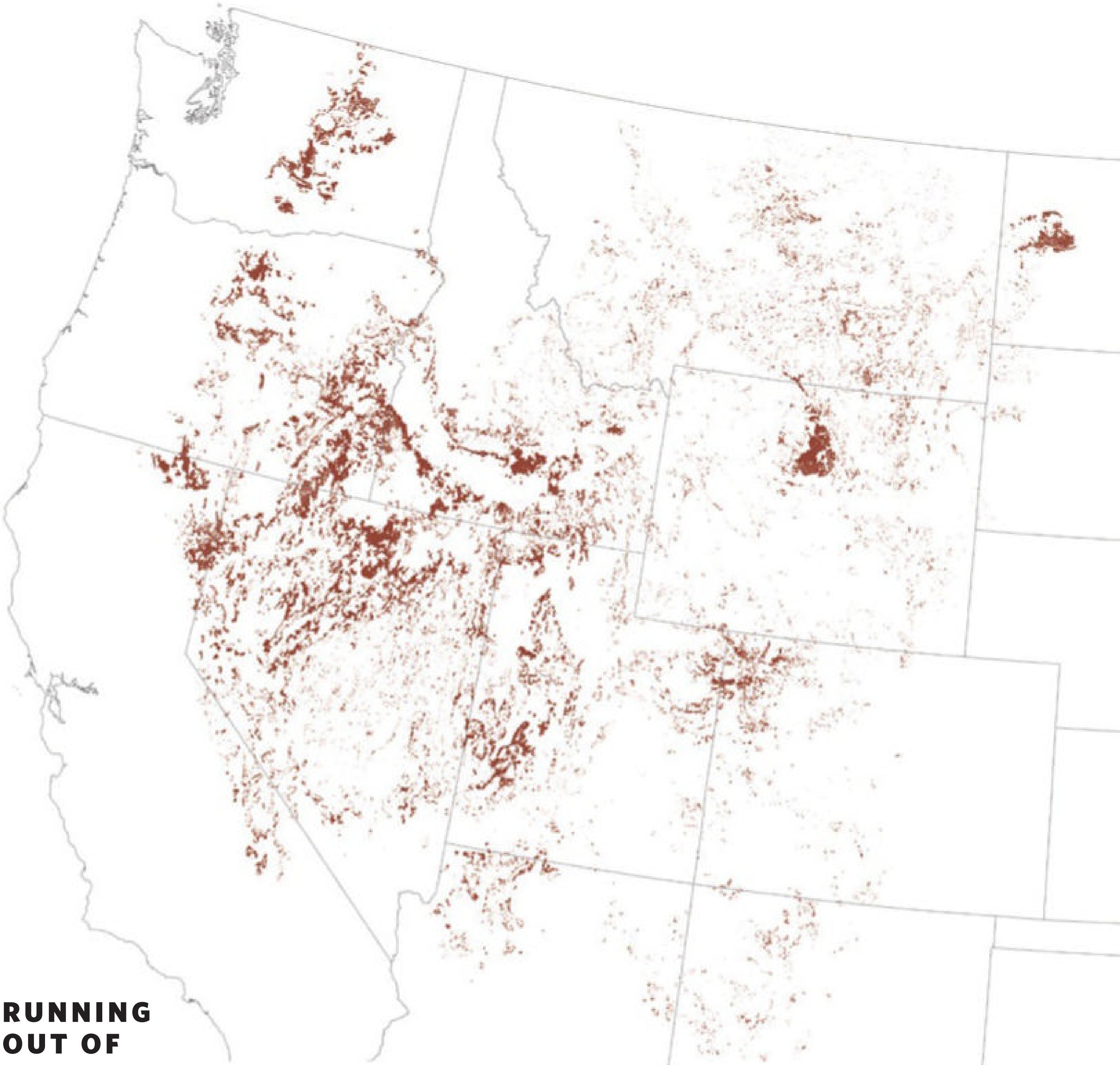
DECLINE OVER THE PAST TWO DECADES

Greater Sage-Grouse and pronghorn, shown above in Wyoming, are among the species that require healthy sagebrush habitat.

PHOTO: GERRIT VYN

How fully the nation seizes that chance will depend largely on the U.S. Bureau of Land Management (BLM), which oversees more sagebrush habitat than any other entity. The BLM is now drafting a sweeping update to Greater Sage-Grouse management plans that will guide land use and restoration across 67 million acres. Expected to be open to public comment this summer, the plans will be informed by a slew of recent science, including the findings of the 2022 study, which offer a road map to conservation priorities: 118 million acres of habitat that can still be protected or readily rehabilitated. The goal is to stave off an endangered species listing for sage-grouse and help the whole biome rebound. "What gives me hope is the idea of lead agencies like the BLM managing creatively and aggressively," says Ted Koch, executive director of the North American Grouse Partnership. "These plan revisions are the BLM's opportunity to do exactly that."

What's more, over the past two years Congress has approved funding at an unprecedented scale to step up restoration efforts, though advocates stress that this beleaguered ecosystem needs sustained investment, not a one-time cash infusion. Ultimately, saving the sagebrush and all it supports will take not just money, but also a massive, coordinated effort by restoration crews and ranchers, state and federal land managers, and local leaders. And time is running out. Ⓐ



RUNNING OUT OF RANGE

■ **26.8 million acres** of **functional sagebrush habitat lost** from 2001 to 2020, an area about half the size of Utah

A multi-agency study analyzed **244.9 million acres** of sagebrush rangelands. As of 2020:

127.2 million were too degraded to function as habitat

84.3 million could still be restored

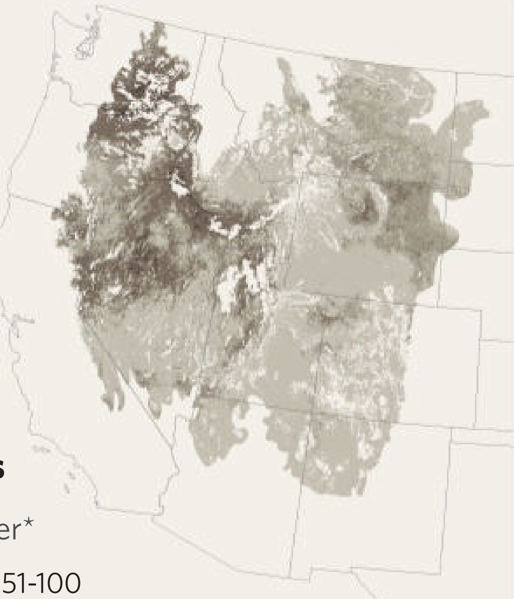
33.4 million remained intact

AN AREA LARGER THAN IDAHO AND OREGON COMBINED

CHEATGRASS CRISIS

Invasive grasses are taking over sagebrush habitat and fueling devastating wildfires.

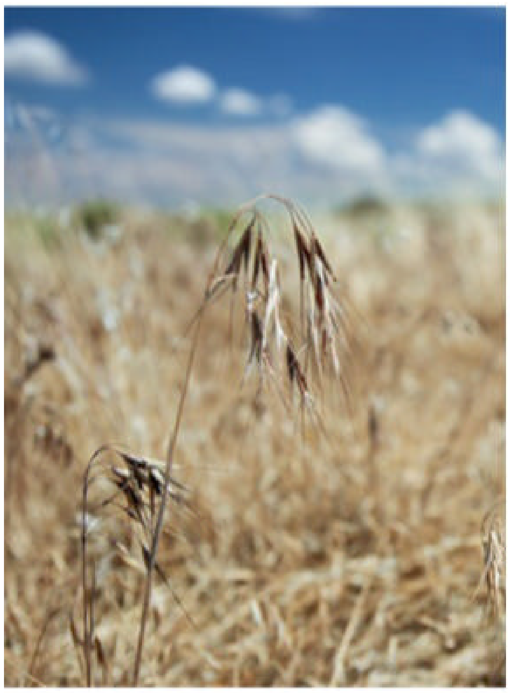
96 MILLION ACRES OF SAGEBRUSH—AN AREA LARGER THAN MONTANA—ARE MODERATELY OR HIGHLY THREATENED BY INVASIVE ANNUAL GRASSES



Percent invasive annual grass cover*

▨ 0-10 ▨ 11-25 ▨ 26-50 ■ 51-100

**Average 2016-2018. Includes a very small percentage of native annuals.*



Highly flammable cheatgrass (left) easily outcompetes slow-growing sagebrush after a fire, creating an ever-increasing need for habitat restoration.

PHOTO: EVAN BARRIENTOS/AUDUBON ROCKIES. MAPS: JULIE ROSSMAN & ELIZA KRONENBERGER/AUDUBON. DATA: USGS/USFWS/WESTERN GOVERNOR'S ASSOCIATION

CONUNDRUM

THE MYSTERIOUS DECLINE OF THE AMERICAN KESTREL

Although still common, these much-loved falcons continue to disappear from North American skies each year. Scientists are racing to understand why.

BY JILLIAN MOCK
PHOTOGRAPHY BY KARINE AIGNER

Maddy Kaleta leads a Texas project that outfits kestrels, like this female, with trackers to glean how they move on their wintering grounds and where they breed come spring.

ON A CHILLY, OVERCAST DECEMBER MORNING in North Texas, a car prowls a pitted dirt road. The occupants are straining forward, looking intently at the sky. “Kestrel!” says Maddy Kaleta from the passenger seat, pointing to a tiny black blob on a power line ahead. She whips out binoculars and confirms the bird isn’t banded. “Let’s go,” says her advisor, University of North Texas ecologist Jim Bednarz. Kaleta grabs a ring-shaped wire mesh cage the size of a small throw pillow with two oblivious mice scampering inside. She opens the car door, leans out, and, as the car rolls to a stop, gently sets the contraption on the grassy shoulder.

Kaleta snaps back inside as Bednarz quickly reverses, stopping a few hundred feet away. The American Kestrel bobs its tail as it scans the muddy fields of a future housing development strewn with construction equipment. The humans are watching, willing it to fall for the bait. “You’re an apex predator,” Kaleta says to the distant falcon. Bednarz joins in, urging the bird to strike: “You’re an eagle! A kestrel eagle.”

As they banter, the colorful predator flies to a wire above the trap, then swoops atop it. After trying to catch the just-out-of-reach mice, the kestrel flaps its wings—but goes nowhere. While trying to snatch the mice, it had slipped a foot through a loop of fishing line sprouting from the trap.

Bednarz floors it, racing the short distance to the captive. As the car rocks to a stop, Kaleta and Brooke Poplin, both graduate students who work with Bednarz, leap out and scoop the trap and falcon off the ground. The robin-size bird doesn’t squawk or flail; it just glares indignantly at the jubilant humans as they untangle it from the fishing line. Victory: They caught an American Kestrel.

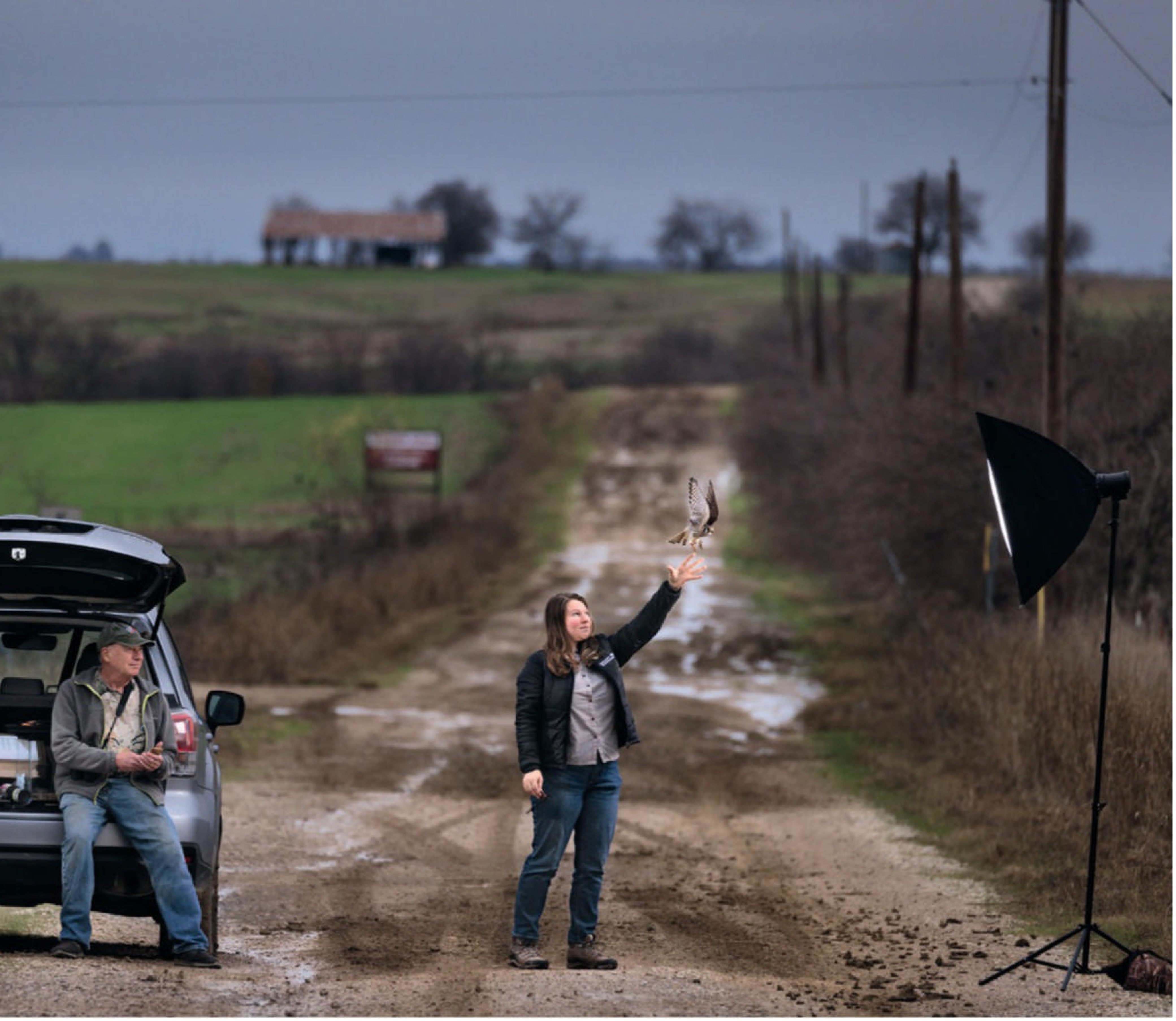
This time of year, Texas is the place to be if you’re looking for kestrels. The state is thought to host one of the country’s largest winter populations, with the feisty falcons flocking to its vast grasslands, agricultural fields, and booming neighborhoods to hunt for insects, rodents, and small birds. Throughout the winter, Kaleta will scour sprawling Denton County to band, tag, and monitor dozens of kestrels. Relatively little research has been done on the birds up and down North America’s central corridor, or during the winter. Her findings could help answer a question that raptor researchers and conservationists across the continent are racing to answer: Why are kestrel populations declining?

No one knows exactly what’s driving kestrel losses or where the birds are running into trouble—making it difficult to figure out how to stop or reverse the trend.

While Bald Eagles, Peregrine Falcons, and other raptor species have rebounded in North America since the banning of DDT in the 1970s, American Kestrel numbers have continued to drop, plunging by an estimated 50 percent. Although the birds are still common, the decrease has scientists worried. No one knows exactly what’s driving the losses or where the birds are running into trouble—making it difficult to figure out how to stop or reverse the trend.

From their perch in northern Texas, Kaleta and Bednarz are perfectly positioned to help find out. They’re working to fill some crucial gaps in the kestrel’s life cycle, capturing valuable information about how birds fare over the winter, their migratory routes, and their survival rates. Still in the early days of their investigation, researchers are making the most of what they’ve got: lots of kestrels, a willingness to drive thousands of miles, a small army of pet mice, and cutting-edge tracking technology.

Unfortunately, the kestrel that Kaleta caught this morning—a male, given his slate gray wings—isn’t going to play a starring role in uncovering the cause of his species’ decline. Once Kaleta frees him from the trap, she keeps him calm by slipping him into a tube



made of two frozen-juice containers taped together. The researchers take measurements, inspect his feathers, clip metal identification bands around his legs, and mark his chest with a smear of blue nontoxic dye so they can tell from afar that they've already captured him. But Kaleta can't attach the location tracker that is essential to her research. The bird must weigh at least 123 grams to safely carry the load of the 3.5-gram tracking device. This one is 11 grams shy.

However, Kaleta isn't worried. This is only day one, kestrel one of the three-month field season. And for now, the tiny raptors abound.

AMERICAN KESTRELS ARE THE SMALLEST, most numerous, and most widespread falcons in North America. They live in semiopen areas ranging from meadows, grasslands, and deserts to parks, croplands, and urban environments. Kestrels are found across much of the continent, from Alaska and Canada down to Mexico; they also occur in Central and South America. Kestrels in warmer regions tend to be year-round residents. Those that breed in colder climates typically migrate south in winter, and many migrants follow a leapfrog pattern—traveling from a more northern latitude, passing another population, and settling even farther south for the winter.

The exact paths kestrels take and the ultimate winter destinations for many populations are mysteries. Their smaller-scale movements are also an enigma: We know kestrels need open space, but we don't know enough about where they prefer to hunt, how big their territories are, or what they do when their preferred habitat disappears. Despite advances in tracking technology that have unlocked the pathways of birds as varied as Golden Eagles, Arctic Terns, and Blackpoll Warblers, it's been tricky to find a gadget that's a good fit for kestrels. The vast majority of knowledge has come from data collected during a fraction of their annual cycle, when they're relatively easy to monitor.

Every summer for decades, scientists and scores of kestrel-loving volunteers across the continent

Before releasing a kestrel, Kaleta and Jim Bednarz (above) mark it with nontoxic fabric dye (opposite) in one of four colors on one of its body quadrants. The color, shed during the postbreeding molt, helps monitor newly banded birds.

have set out to learn as much as they can about the birds. Some take part in the North American Breeding Bird Survey, counting the number of birds, including kestrels, they see on a single day at regular stops along established routes. Over the past half century the number of kestrels that participants have sighted has dropped throughout North America.

Enthralled by the birds’ charisma, some observers dedicate more time. Kestrels are cavity nesters that readily inhabit human-made wooden boxes to raise their young, and some return to the same spots year after year. Across the country, from roughly March through August, hundreds of volunteers regularly check thousands of nest boxes on public lands and in backyards to monitor how many chicks successfully hatch and fledge. Data from these studies indicate the sharpest kestrel declines are in the East. “For the birds that show up to nest boxes, their success rates are very high,” says John Smallwood, a biologist and raptor researcher at Montclair State University in New Jersey, of his study area. A single kestrel pair fledges three to four chicks on average. The puzzling problem: “They’re not showing up.”

In at least some parts of the West, kestrels are showing up, but they are breeding weeks earlier than they did in the 1990s. Curious about the change, Julie Heath, a biologist and raptor researcher at Boise State University, discovered that farmers are taking advantage of significantly warmer winters by planting crops earlier to avoid the hotter summers. The bounty draws insects and rodents—prey for kestrels—to the fields. “It looks like kestrels are really tracking that change,” she says.

Another major source of data comes from decades of fall migration monitoring—also a labor of love. Each autumn, as raptors of all kinds fly south, scientists and volunteers gather at high points, coasts, and lakeshores across the continent to tally birds passing overhead. These migration counts suggest that, as with nest-box studies, kestrels in the Northeast are declining fastest. Counts in the West, meanwhile, seem to point to a shift in behavior, with fewer kestrels migrating in the fall and more staying through the winter, says Dave Oleyar, director of long-term monitoring and community science at HawkWatch International in Utah.

Researchers have spent years looking for a smoking gun that explains the declines. They’ve tested blood droplets and feathers for chemicals, but to date no pollutants have popped up as a prominent culprit. Genetic analysis of samples revealed five distinct kestrel populations—Alaska, Western, Eastern, Texas, and Florida. (This finding opened the door to yet another question: If populations aren’t mixing, how are they different from one another?)

Experts now believe multiple complex factors are likely the problem. Possibilities include loss of insects and other prey due to climate change and habitat alteration. Pesticides may be killing rodents and insects or weakening the falcons themselves; neurotoxic insecticides called neonicotinoids are especially concerning because they’re potent, widely used, and spread up the food chain. European Starlings may be outcompeting the native birds for natural nest cavities, and predation by larger Cooper’s Hawks might play a role. How these factors interplay, and how they might differ across geographic areas, is still unclear.

In total, North America has lost an estimated 2 million kestrels since 1970, says Chris McClure, executive vice president of science and conservation at The Peregrine Fund. No one disputes kestrels have long been declining, but the pace of the drop-off has also been a subject of debate. Some research suggests there’s been a steady decrease, a trend that would ultimately lead to extinction if unchecked. A more recent analysis concluded that the rate has lessened in the past several decades, which suggests a less dire fate.

There’s still time to ensure the kestrel remains the most abundant falcon on the continent, but doing so will require embracing new tools and looking in places—and during parts of the species’ life cycle—that are understudied. “It’s my personal opinion that the problems that are causing the American Kestrel decline are happening outside of the breeding season,” McClure says. “And Texas is a really concentrated wintering area for the American Kestrel.”

There’s still time to ensure the kestrel remains the most abundant falcon on the continent, but doing so will require embracing new tools and looking in understudied places.

FOUR HOURS AFTER KALETA’S TEAM CAUGHT their first kestrel, the gray winter sky has given way to a clear blue, the temperature has warmed into the 60s. They’re still out prowling back roads and eyeing treetops and utility lines for falcon-shaped blobs.

Driving past a field of long golden grasses and live oak thickets, Kaleta spots one. She pulls over and checks on her furry accomplices, Chimay and Charcoal Cheddar. These two mice, and the four others in a glass habitat in the trunk, are her permanent pets. She’s named all six after cheeses and jokes about their distinct personalities: Blue has a mild temperament. Manchego is curious and quick. Today, wily Chimay and fleet-footed Charcoal Cheddar soon prove their value once again, this time luring a female hefty enough to be fitted with a tracker.

To attach the device, Kaleta loops a harness made of thin black Teflon around the kestrel’s wings and secures it and a thimble-size tracker with two antennae high on the bird’s back. She fixes the knot with waxed cinnamon dental floss soaked in Krazy Glue. The process takes about 15 minutes. But getting to this point took trial and error—and technological advances.

Bednarz started UNT’s American Kestrel project in 2016 and enlisted undergraduate students to estimate annual kestrel survival by banding and resighting the birds. A Ph.D. student, Kelsey Biles, took over the project a couple of years later. Bednarz and Biles wanted to expand the focus to track where kestrels that winter in Texas go to breed. No one knew.

Just figuring out how to track the birds was a challenge. Unfortunately, satellite tags weren’t an option: They transmit location information, but the battery power they require makes them too heavy for pint-size kestrels. Weight wasn’t a concern with nanotags that emit radio signals, but the birds’ locations would be recorded only when they flew close enough to a stationary antenna site on land and wouldn’t provide the granular picture of kestrel movement the researchers were after. Biles tried geolocators, but

📷 Kestrels are sexually dichromatic; males, like this one, have blue-gray wings while females have rufous wings. The species also exhibits sexual size dimorphism; females are about 10 percent heavier.

Kestrels that spend one winter hunting in a field may return to find it has disappeared under concrete and new shopping attractions the next.

they proved to be a bust: The tiny sensors record daylight to estimate location, and kestrels spend too much time in dark cavities to provide useful information. She also tried archival GPS tags, which had been developed only a few years earlier. These satellite tags store position data until scientists recapture the bird and download the information; they require far less battery power than tags that transmit on their own and thus are light enough for a kestrel to carry.

Biles put the GPS tags on 10 birds in the winter of 2019–2020. When eight returned the next year, she was elated. Then dismayed. Although seven of the Teflon backpacks had withstood the kestrels' razor-sharp beaks, Biles quickly realized she couldn't get them off—because she couldn't recapture the birds. The kestrels returned to the same areas where she'd first snared them, but they refused to be enticed by her mice. Apparently you can fool a kestrel only once.

Thankfully, in 2020, The Peregrine Fund supplied the team with archival GPS tags paired with a radio beacon that beams data at a preset time, enabling the scientists to download data from several hundred feet away using a handheld antenna. No recapturing suspicious kestrels required.

With this technological breakthrough, the project could move forward. Biles and Bednarz tagged 20 kestrels from December 2020 to March 2021. Kaleta took over the project that fall, and the following winter she spotted seven birds sporting backpacks. She successfully retrieved data from two (either the others had dead batteries or Kaleta missed the window when they were beaming the data). One bird had spent the summer about 600 miles north in a riverside wildlife refuge in Nebraska. The other kestrel's tracker battery died in April, but the data Kaleta managed to recover suggested it may have migrated to northern Kansas. As of early March 2023, she had deployed 18 trackers this season. She also found seven birds tagged the previous winter, but she was unable to retrieve their data immediately due to technical glitches, including four failed downloads. "New technology is definitely tricky," Kaleta says. Her team is still trying to recover the data and hopes that what they learn will help improve the gadgets.

In addition to tracking, the team bands kestrels in winter and surveys birds year-round. Biles, now conservation director at Houston Audubon, determined that 90 percent of the kestrels in Denton County in winter are migrants. Since the start of the project, the team has collectively banded about 400 kestrels. Survey efforts step up in the winter months, with Kaleta and a small team of field technicians scouring the county looking for kestrels that were banded the year before and tracking when and where they return.

The team gathers an unprecedented wealth of information, but they also need to understand it. Kaleta plans to analyze the data on resighted kestrels to determine survival rates, whether birds are dying in high numbers during the winter, and which factors, like age, sex, and rural versus urban habitat, may play a determining role. Tracking more kestrels throughout the year could also help the researchers determine if certain migratory pathways or stopover sites are associated with lower return rates by pointing to areas where the birds are running into trouble.

So far, only the UNT team and a few other scientists have outfitted the birds with archival GPS tags, but Bednarz has heard from other kestrel scientists who are interested in using the same technology. If the trackers prove successful, The Peregrine Fund may distribute them to kestrel researchers in other areas where the birds overwinter and pass along the methodology pioneered in Texas. And as more kestrels are tracked in the coming years, the bigger picture of their migration and how they interact with the various landscapes they inhabit may come into focus.

DRIVING AROUND NORTH TEXAS IS A SOBERing reminder of the fragility of the open-space habitats that kestrels need. Denton is part of what locals call the metroplex: Dallas, Fort Worth, and the surrounding smaller cities. As in much of the state, the population of the metroplex is expanding and sprawling rapidly. What were once prairie and woodland are increasingly big-box stores and cul-de-sacs.

Kestrels gravitate to the edges of these developments. In many ways, they've adapted to humans, says Bednarz. Such sites provide seemingly ideal kestrel habitat, with open undeveloped fields for hunting on one side and human structures full of cozy cavities for roosting on the other.

But the development front is constantly expanding. This encroachment creates an ecological trap for the birds, Bednarz says. Kestrels that spend one winter hunting in a field may return to find it has disappeared under concrete and new shopping attractions the next. "My hypothesis is it's a contributing factor in the decline happening all over," he says.

A new effort spearheaded by researchers in New Mexico could help identify whether urbanization, which has been on the rise for decades, is indeed a main pressure driving kestrel losses. The scientists plan to feed the growing volume of kestrel data from bird bands, nesting records, and surveys conducted by thousands of experts and volunteers into one giant, continent-wide computer model.

Their work is rooted in the field of "decision science," a high-concept term created in the business world and adopted by the U.S. Department of the Interior and other wildlife policymakers. It involves integrating everything scientists know about a species into a powerful model. Researchers then work with species experts to develop hypotheses about possible causes of declines and actions that might address them. Finally, they build smaller-scale population models that vacuum up all relevant information—including factors like land cover and climate data—to tease out the most plausible explanations.

As anyone who has ever tried to make a complex decision with limited information and resources knows, there's usually no single "right" answer, but the scientists hope the model will inform the best possible choices. The project is led by Abby Lawson, a population ecologist at the USGS New Mexico Cooperative Fish and Wildlife Research Unit based at New Mexico State University. She's led similar work on species including Eastern Black Rails. Though data on the secretive marsh birds are scant, Lawson says, the coordinated effort allowed researchers to identify two credible hypotheses to test in the field—one that targets reducing woody vegetation and another focused on identifying optimal irrigation regimes. They also worked together on several big-picture proposals to win competitive research grants.

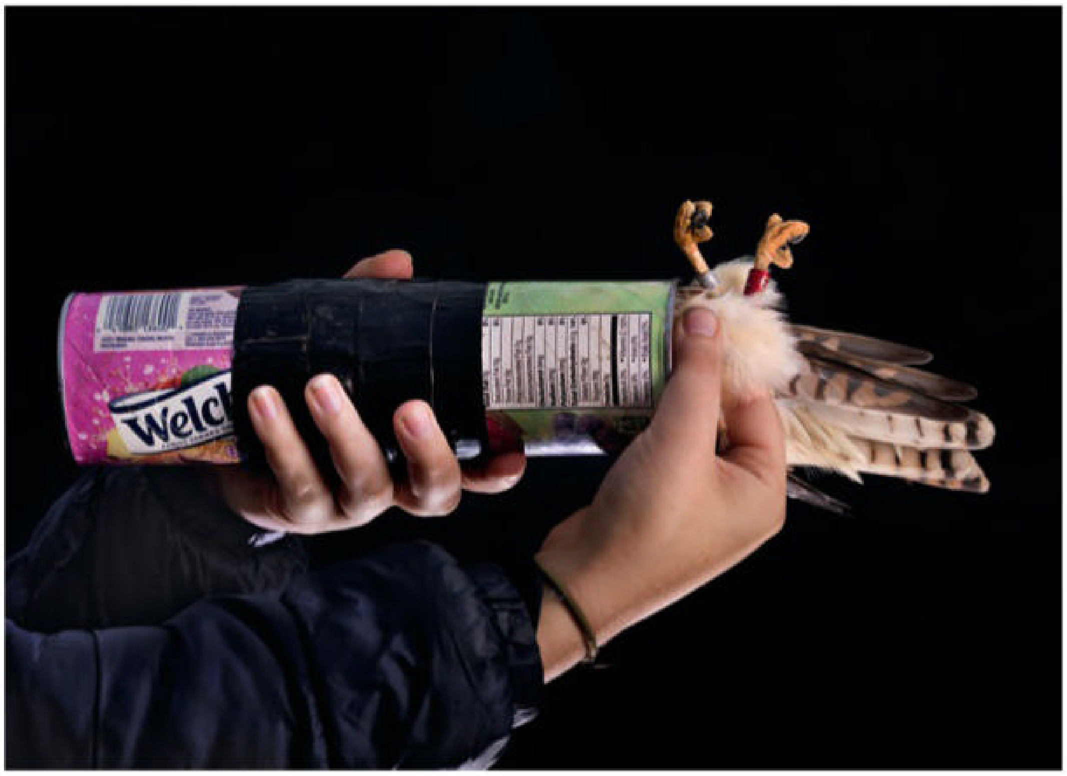
For kestrels, possible actions may include putting up nest boxes in new areas, managing or restoring specific kinds of habitat, and reducing pesticide use on farmland. The model can then estimate the impact of those actions on kestrel populations, indicating which measures may slow or even reverse population declines and are therefore worth prioritizing and funding. Scientists hope the model will also point out the more significant causes of decline, says Kristin Davis, a postdoctoral researcher on the project.

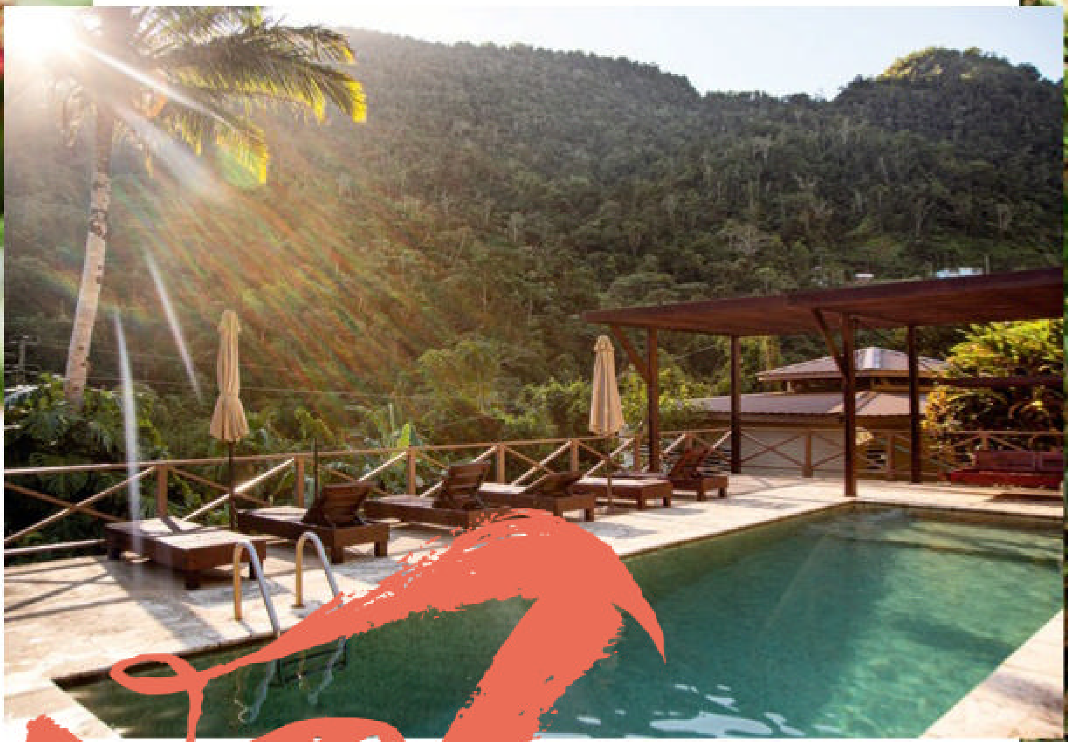
Such insights will likely yield widespread benefits. "Birds like kestrels, they are such good conservation tools because they're colorful; they're charismatic; people love raptors," says Chad Witko, Audubon's senior coordinator of avian biology for the Migratory Bird Initiative. "If we can protect them and protect their open-space habitats, you're going to protect a lot of other species that fall within those habitats."

No one knows what happens to kestrels when they return to their hunting grounds after a summer away and find not a field but a gas station or a block of apartments. But by monitoring the birds closely, the scientists in Denton might just be the ones to figure out how adaptable these raptors really are—and what challenges they need our help to overcome. Ⓐ

Journalist **JILLIAN MOCK** *grew up in Dallas and resides in New York City.* **KARINE AIGNER** *is the 2022 Wildlife Photographer of the Year; her work focuses on stories at the intersection of animals and humans.*

After Brie and Chimay (opposite) entice a kestrel from the safety of their wire mesh trap, Kaleta quickly places the small falcon into a homemade canister (below) that keeps the bird safe and calm as she bands, weighs, and measures it.





Travel IN THE TIME OF CLIMATE CRISIS

As climate-related disasters ramp up, how can tourists minimize the harms and maximize the benefits they bring to recovering destinations?

BY RACHEL NUWER

PHOTOGRAPHY BY ERIKA P. RODRÍGUEZ

PROFESSIONAL BIRD GUIDE Gabriel Lugo was looking forward to another busy season of tours when Hurricane Maria slammed into Puerto Rico on September 20, 2017. The Category 4 storm—the fourth costliest on record to hit the United States—caused more than 70,000 landslides, flattened homes, and plunged much of the island into nearly a year of blackouts. Immediately, all seven groups who were booked with Lugo canceled.

As weeks turned into months, Lugo picked up work in construction. Birding was starting to feel like a calling from a past life when he received a message that gave him hope: Two sisters from Brooklyn wanted to move forward with a January trip they'd planned months earlier. Would there be anything for them to see?

Lugo launched into action, visiting favorite spots to check how the birds were faring, and reported back with encouraging news: "Yes, we've got all the endemics." The sisters,

LUCHA HASTA QUE LA
DIGNIDAD
SE HAGA

📷 Clockwise from upper left: Bananaquits visiting a feeder; the inviting pool at Casa Grande Mountain Retreat; Joseph Wunderle, an expert on the effects of hurricanes on Caribbean birds; Ada Ramona Miranda Alvarado preparing coffee from beans she grew, roasted, and ground; El Yunque National Forest still in recovery from Hurricane Maria five years later; a sign about critically endangered Puerto Rican Parrots; the author with bird guide Gabriel Lugo; a tower leading to vistas of the rainforest.

Faro de Fajardo
Laguna Grande
Fajardo Lighthouse
Las Cabezas de San Juan Bay
Laguna Grande
Caribbean National Forest

meanwhile, contacted hotels—which despite still relying on generators for power were booked almost solid by cleanup workers—and managed to secure a room. They spent several days with Lugo and saw 116 species. “It was pretty awesome, because I got to do what I like to do,” Lugo says. More importantly, though, “it kind of gave me a little sense of normality.”

Lugo was lucky to find other work until tourists started returning. Many have been less fortunate, and I have seen firsthand the devastation that can ensue when the tourism industry is pulled out from under a place that depends on it. I was living in New Orleans when Hurricane Katrina hit in 2005, and I frequently travel for my journalism work and for pleasure, including to places that have recently experienced disasters. On trips to Nepal shortly after the 2015 earthquake and to Sri Lanka following the 2019 Easter bombings, I met people who, over and over, told me of their struggles after tourists disappeared virtually overnight. They implored me to send my friends. They told me they were desperate.

“IF YOU’RE NOT CAPABLE EMOTIONALLY OF TREADING SOFTLY, THEN DON’T GO—IT’S NOT FOR YOU.”

As global warming accelerates, climate-driven disasters are becoming more commonplace. This means tourists must increasingly grapple with difficult decisions about whether and when to visit affected areas—and how to do so in a way that helps rather than hurts. Heat waves, floods, droughts, water shortages, wildfires, and storms threaten the lives and livelihoods of Lugo and millions of others around the world who depend on tourism. And while the travel industry itself contributes to greenhouse gas emissions, the reality is that people are going to travel—and many local economies depend on us doing so.

Puerto Rico is a fitting destination for exploring these issues because the Caribbean is the world's most tourism-dependent region. The island, which derives about 7 percent of its GDP from the industry, is popular with mainland Americans, and birders who seek some of the more than 350 species found there, including 18 endemics. Yet like many other travel destinations, Puerto Rico and the broader Caribbean face a future increasingly prone to disasters that may drive vacationers away. In 2017, for example, Hurricanes Harvey, Irma, Maria, and Nate cost the region more than $1 billion in lost tourism revenue, including for islands that weren't directly damaged. Yet tourism can also be a force for recovery. After the pandemic slump, Puerto Rico, for instance, saw a record number of visitors in 2021, generating about $98 million in tax revenue and support for many jobs.

Even in the best of circumstances, it is challenging to make genuinely beneficial vacation decisions. Greenwashing abounds in the travel industry, and ensuring your money flows into local economies isn’t nearly as simple as making a reservation at an all-inclusive resort. That process, I learned, becomes even more complex after a natural disaster.

Last fall, just weeks after Hurricane Fiona had hit Puerto Rico and caused significant flooding and blackouts on an island still reeling from the effects of Maria, I set out to plan and make such a trip. While taking in the stunning landscapes and birdlife that

The beauty and sustainable practices of Casa Grande Mountain Retreat (left) drew the author (below) to the hotel. Lugo (bottom) has guided tourists in the Caribbean in the aftermath of hurricanes.

make the island a popular vacation destination, I wanted to hear directly from Lugo and others on the ground about what they need most from tourists like me. As climate change continues its insidious march, now is the time to reconsider how we travel so that visitors can try to minimize the harms we bring to places in recovery and maximize the much-needed benefits.

DETERMINING WHEN TO VISIT PUERTO RICO ENDED up being one of the easiest decisions of planning my trip. By November, six weeks had passed since Fiona hit, and news reports, as well as Lugo and others I was in touch with, reassured me that damage had been relatively minimal. My four-day trip would take place in early December, right after hurricane season officially ended and before tourism peaked. It seemed like an ideal window—so long as no off-season storms popped up, given that climate change is making long-standing annual weather patterns more and more unpredictable (fortunately, none did).

For any trip in the wake of a disaster, figuring out appropriate timing is key, C.B. Ramkumar tells me. He is vice-chair of the Global Sustainable Tourism Council, a nonprofit that manages global standards for the industry, and one of several experts I called in my early planning stages. Come too soon and "you'll get in the way," he says. Yet he advises not writing off an entire country following a hurricane, flood, or wildfire. Once the dust has settled, your presence can be an economic boon to a place still in partial recovery mode. As important, he says, is that visitors help revive life. "Tourists bring an emotional quotient to the recovery."

Experts I spoke with suggested looking into the specifics of what's happening on the ground. While one region might be impacted, another might be totally fine. Setting a Google alert for the destination you want to visit can give you an idea of when it's okay to go, Ramkumar says. You'll get lots of irrelevant stories, but skimming over the daily headlines will lend a sense of how general recovery efforts are progressing. For more direct insight into when a country or area is ready to welcome visitors back, follow the social media accounts of local hotels and government tourism agencies. For places that are dealing with lasting impacts, making advance reservations for future trips, before hotels and restaurants reopen, can be a big financial and emotional help, too.

One of the most important steps is choosing accommodation that supports, rather than exploits, the place you're visiting. For Puerto Rico, this means avoiding new beachfront hotels, because "almost 100 percent" are built on prime wildlife habitat that serves as natural buffers for hurricanes, says Adrianne Tossas, president of BirdsCaribbean and an avian ecologist at the University of Puerto Rico. "If people coming here were knowledgeable about this, they could make better decisions on where to stay."

Paloma Zapata, chief executive of Sustainable Travel International, a mission-driven organization committed to transforming the impact of tourism on nature and people, also encourages travelers to look for places that give some indication of their commitment to their employees and to the environment. "If they don't talk about it, probably they're not doing much about it," she says.

Booking accommodations that meet these criteria can be challenging, though, and climate-driven disasters can make it even harder by, for example, limiting the hotels in operation. In my case, laborious online searches, an outdated *Lonely Planet*, and weeks of emails with a Puerto Rico tourism representative yielded just a few properties that specifically talked about sustainability. Almost all were either permanently closed or under repair, mostly thanks to Maria, or fully booked for my dates. This is typical for a place in recovery and illustrates the need to be flexible and patient, says Ramkumar. "If you're not capable emotionally of treading softly, then don't go—it's not for you."

After several weeks of searching, I finally found what seemed like the perfect accommodation: Casa Grande Mountain Retreat. The hotel, which stands on the site of a former 20th-century coffee farm, was almost completely demolished by Maria and took nearly four years to reopen. The restaurant serves only vegan food made from fresh, local ingredients (a rarity in Puerto Rico, which imports more than 80 percent of its food thanks in part to long-standing U.S. colonialist trade policies). Other environmental perks include a spring-fed pool, eco-friendly soap and

cleaning products, on-site composting, and motion-activated outdoor lamps. Reservations come with complimentary yoga but no Wi-Fi. "It's like a reset," María Victoria la Tanamá, the hotel's general manager, later tells me. "There's so few places left like this in the world."

Casa Grande only lost electricity temporarily, but Fiona still scared some guests away. "We had people canceling for events in March," la Tanamá says with a sigh. "We're like, 'We're fine! We're open! You can get here.'"

Reaching Casa Grande requires following a tight, winding trail of a road that snakes through Puerto Rico's dramatic Central Mountain Range, whose sharp limestone cliffs are covered by careening billows of mosses and ferns. Rustic homes precariously cling to slivers of land like nests on a precipice, and bright orange gashes, the remnants of landslides from Maria and Fiona, occasionally run down the mountainside. By the time I pull up at Casa Grande—a series of simple but elegant casitas nestled into the greenery—the valley is cloaked in early evening shadow, and the coqui frogs are beginning to chirp. *How utterly black the nights must have been in the long year after Maria,* I think.

With logistics settled, I'm finally ready to see some birds.

THE NEXT MORNING, I MEET LUGO FOR BREAKFAST on the hotel's expansive open-air patio. It's 8 a.m., but Lugo has been up for several hours already, listening to the dawn chorus and filming time lapses of the sunrise (it looked incredible, based on his footage; I was still dreaming when he shot it). Before our coffee arrives, he points out a male American Kestrel snatching up a lizard. By the time our breakfast is served—vegan omelets and chia pudding decorated with edible flowers—he's entered eBird records for a Venezuelan Troupial, a Loggerhead Kingbird, a Puerto Rican Bullfinch, a Puerto Rican Spindalis, several White-winged Doves, and two Smooth-billed Anis. "With that soft light, the beauty comes out very well," he says with delight, peering through binoculars at the anis, which resemble ravens with flamboyantly long tails and extra-thick beaks. "This is a bird people overlook, but they're beautiful!"

Lugo got into birding by chance about 17 years ago, when he was working as a water treatment plant operator. Members of the Puerto Rican Ornithological Society (SOPI) visited the facility for the Christmas Bird Count, Audubon's annual community bird survey. "I'd never heard about anyone who goes and counts birds, but I'd always loved nature," he says. "I asked if I could go with them, and that was it." He joined Wildside Nature Tours a few years later, after he met its owner, Kevin Loughlin, while both searched for the Elfin-woods Warbler, an endangered endemic. Today Lugo leads tours in Puerto Rico, three other Caribbean islands, and the mainland United States.

AREA
CLOSED

TIPS FOR MAKING A TRIP

① **Choose lodging that gives back.** Look for hotels with stated commitments to the environment or employees. Avoid new places built on habitat like beaches or mangroves, which act as natural storm buffers and carbon sinks. Book directly with hotels; online platforms usually take a 10- to 25-percent cut. After a disaster, the extra income can be especially important.

② **Minimize waste and emissions.** Bring a water bottle and utensils, and avoid packaging. Islands, in particular, often have no recycling facilities and overburdened landfills—even more so amid post-disaster cleanup. When possible, take a bus, ride a train, bike, or walk.

③ **Think local everything.** Patronize local restaurants and artisans. Hire in-country guides; they'll know the best spots and safest places to visit after an event. For guides in the Western Hemisphere, visit audubon.org/ecotourism and caribbeanbirdingtrail.org/guides. *—R.N.*

Choosing a local guide rather than someone who parachutes in helps ensure your dollars are assisting with recovery—and that you'll have a rewarding trip to boot. Local guides take clients to locations off the beaten path, Lugo explains, to places they know will be great for birds and where they can "support people normally not supported by the crowds." They're also aware of conditions on the ground, so they'll know which areas to avoid after a disaster, and they're the best people to have around should something go wrong, like an unexpected road closure due to flooding or a landslide. For these reasons, Lugo always works with a local partner when he leads trips outside Puerto Rico. After Hurricane Ian hit Cuba in September, for example, Lugo's Cuban counterpart was able to quickly verify that the accommodations they'd booked all had power, allowing a birding trip in November to move forward.

Lugo took me to one of his favorite exclusive birding spots, the home of bird lovers and Puerto Rican Tody experts José "Pepe" González and Felisa Collazo. Three decades ago, they turned their yard into a paradise for hummingbirds, setting up feeders and landscaping with nectar-rich plants. When I arrive, seven Green Mangos and one Puerto Rican Emerald are vying for space at the feeders—a squeakfest of tiny, luminous bodies with big attitudes.

While hurricane damage shuttered parts of El Yunque (opposite), opportunities abound for tourists to explore Puerto Rico's tropical forests, seek out Green Mangos and other stunning birdlife, and kayak at night in bioluminescent bodies of water.

The couple's home served as a lifeline for many nectar-feeding birds after Hurricane Maria. The landscape impacts, González recalls, "were like a bomb." Not a single flower seemed to survive. He counted more than 50 birds visiting his feeders the day after the storm.

To better understand how birds respond to hurricanes, I head to a can't-miss spot for many travelers. El Yunque is the only tropical rainforest in the U.S. National Forest System, and its 1.2 million annual visitors account for 20 percent of Puerto Rico's tourism economy. Its popularity likely put pressure on the agency to seek congressional funds for restoration and repairs after Maria, says Joseph Wunderle, a Forest Service emeritus research scientist.

For a quick lesson on climate disasters' double threat to tourism and biodiversity, Wunderle and Laura Fidalgo De Souza, president of SOPI, bring me to the forest's Yokahú Tower, a popular stop for day-trippers. Atop the 69-foot-tall structure, I'm rewarded for the StairMaster-like workout with a view of lush green that stretches all the way to the sea. After Maria, I'm told, all of this was brown. "Imagine you go from summer to winter overnight, with not a green leaf left," Wunderle says. "The shock is just that."

Based on decades of study in El Yunque and elsewhere, scientists now know that hurricanes don't impact all Caribbean species equally. While many birds survive the wind and rain, "the problem is afterwards, when starvation can take place," Fidalgo De Souza says. Fruit, seed, and nectar feeders suffer most, and imperiled species confined to small patches of habitat are at the greatest risk of all. This is because storms uproot trees—Maria killed or severely damaged an estimated 30 million to 40 million in Puerto Rico alone—and strip surviving ones bare. Predators and insectivores, conversely, tend to do better. After Maria, SOPI distributed seeds, sugar water, and more than 100 hummingbird feeders to local partners. Wunderle says the efforts were likely lifesaving for some of Puerto Rico's five hummingbird species, plus other nectar feeders like Bananaquits: "Did it pull them through the bottleneck? We suspect so."

> FOR MANY PLACES THAT HAVE SUFFERED CLIMATE-DRIVEN DISASTERS, THE RETURN OF TOURISM HAS BEEN, OR WILL BE, AN ESSENTIAL COMPONENT IN THEIR RECOVERY.

From the tower, Wunderle points out a Red-tailed Hawk circling overhead. The species weathered Maria better than most, he notes, and also eats the critically endangered Puerto Rican Parrot, one of the birds hit hardest by the storm. The parrots numbered around 55 in El Yunque prior to the hurricane, but after the direct impact, scientists observed only two survivors. With sparse fruit and seeds to eat in the weeks following, those two went down to zero, likely from starvation and predation.

Fortunately, another population of wild Puerto Rican Parrots survived elsewhere on the island, as did those in the two aviaries—including the one at El Yunque rebuilt in 2006 thanks in no small part to $750,000 in international donations. An estimated

Continued on page 54

BUSINESS IS BLOOMING

This page: A sunflower, one of many that may become birdseed, soaks up sun in a South Dakota field. Right: A grain elevator worker grabs a handful of sunflower seeds.

Feeding birds has always been popular, but interest exploded during the pandemic, with a surge of people joining the ranks and products flying off the shelves. Can this momentum carry the century-old hobby into a new era?

BY KEVIN DUPZYK
PHOTOGRAPHY BY
GREG LATZA

Robert Armanini opened his birdseed store, Feed the Birds! in Croton-on-Hudson, New York, in 2010. He'd moved out of New York City 18 years prior, and a new home closer to nature sparked an interest in feeding wild birds, leading him to eventually start his own business. Feed the Birds! sells birdbaths, birdhouses, a multitude of bird feeders, and premium seed mixes that include a proprietary blend of Armanini's own design containing black oil sunflower seeds, peanuts, safflower, and sunflower hearts—a calorie-packed product that's richer in energy than a basic birdseed mix.

For the first 10 years, business was good. Armanini's bread-and-butter customers have always been upper-middle-class people in their 50s, and there are plenty of them in the area, which has only one other specialty retailer offering high-quality seeds and mixes. "Every new homeowner eventually comes through here," Armanini says.

But when the COVID-19 pandemic struck in March 2020, Armanini closed his doors. He and his wife, Maria, who owns the store with him, are middle-aged, too, and they weren't taking any chances with their health. At the time, Feed the Birds! didn't have a website, so the Armaninis offered to take customer orders over the phone, which they'd fulfill and leave outside for pickup.

The phone rang off the hook.

“At some point we were debating hiring someone to answer the phones,” Armanini says, laughing. Feed the Birds! did very well during the pandemic, with sales spiking throughout 2020 and 2021. Much of that surge was due to new customers. “Most of them stayed,” Armanini says. “Sales have remained consistently up.” A good business had become a great business.

Similar economic success stories were repeated across the country. Take the chain All Seasons Wild Bird Stores, which began as a single shop in the Twin Cities region of Minnesota when, in 1991, Al Netten decided to purchase a feed store that he had frequented as a customer. Today the Netten family runs five locations, and their customer base also expanded during the pandemic, says Al’s son Dave: “Feedback from my different store managers was that they were seeing younger families and people that haven’t been a big part of our business coming through the door.”

This sharp uptick in interest goes beyond anecdotes. When the Wild Bird Feeding Institute, an industry trade group, conducted market research in July 2021, 11 percent of people who fed birds had started the hobby during the pandemic. With plenty of time to observe birds while staying home, about a third of people overall increased their purchases of feed and feeders. And notably, growth was strongest among young people, not typically the hobby’s audience, and women, who took up bird feeding at a higher rate than men.

TIP!

Two common sunflower varieties provide the striped and black oil seeds commonly found in mixes. Many birds eat both, but the latter is by far their favorite.

At a glance, this wave of new consumers and the success of retailers like the Armaninis and the Nettens might seem like a straightforward story of a sudden change of circumstances goosing demand—in which case, you might think everything would soon go back to normal. After all, although there have been periods of growth before, the world of bird feeding has remained relatively the same over the decades. But as in other corners of the business world, the hardship of COVID-19 had a silver lining for the birdseed industry: The pandemic rewarded innovation and revealed opportunities. And so far, those who saw success may be helping to grow the hobby in a whole new direction.

To understand the current state of bird feeding, it helps to know the hobby’s roots. The practice certainly didn’t start with Henry David Thoreau, but his description of tossing corn to birds at his cabin in his 1854 classic, *Walden,* perfectly captured the experience of bird feeding at the time. The country was still largely rural, and people who explored attracting birds with food used grain from their own land and homemade feeders. But by the 1920s, ads for seed mixes and ready-made feeders could be found in the pages of catalogs and magazines such as this one, then named *Bird-Lore*. The consensus at the time—since disproven—that birds wouldn’t survive the winter without supplemental food spurred a growing public interest in feeding birds and a cottage industry to support it. Then the Great Depression hit, and from that calamity, in many ways, emerged both the modern practice and business of wild bird feeding.

During the Depression, the nation’s conservation ethos began to deepen, particularly as the federal government established outdoor work programs like the Civilian Conservation Corps. In a sign of the times, the first edition of Roger Tory Peterson’s *A Field Guide to the Birds* came out in 1934, smack in the middle of the doldrums, and promptly sold out—despite costing nearly three times as much as the de facto standard bird guide at that point. Against that backdrop, the conviction that feeding birds helped them was incredibly compelling. According to *Feeding Wild*

NORTH DAKOTA AND SOUTH DAKOTA GROW MORE THAN 70 PERCENT OF THE U.S. MARKET’S SUNFLOWERS.

Above: A combine harvests ripened sunflowers on a fall day in South Dakota. Right: Trucks outside a grain elevator that stores seeds for purchase.

Birds in America, a popular history of the early years of the hobby, "bird feeding continued and even grew" throughout the Depression.

But the appeal of feeding birds ran even deeper. Watching birds was a tonic for isolation. As a result of the economic crisis, people who had fallen on hard times increasingly kept to their homes, social distancing for an entirely different reason than we would 90 years later. They found, much as we did, that their yards were their own slices of nature, free to observe and enjoy—along with any creatures they could coax in.

Today, a growing body of scientific inquiry has found that observing birds has positive impacts on mental health, which may help explain why millions upon millions of people have, in time, found bird feeding to be such a powerful draw. As of the last report from the U.S. Fish and Wildlife Service's National Survey of Fishing, Hunting, and Wildlife-Associated Recreation, nearly 57 million people aged 16 or older fed wild birds in 2016, spending an astonishing $4 billion on the hobby. And that was before the pandemic bump.

ILLUSTRATIONS: JULIE ROSSMAN/AUDUBON

FARM TO FEEDER

A product that can start as a crop in Colorado or Kansas before winding up on store shelves from coast to coast follows a lengthy supply chain.

SOW

Farmers plant crops in the spring, accounting for seeds they have in storage and estimates for domestic and global market demands. The numbers are staggering: In 2022, roughly 1.5 million acres of black oil sunflower were planted, and typically 20 percent of a harvest—equivalent to 225,000 football fields—goes to bird food.

HARVEST

Depending on the crop, harvesting happens from late summer well into the winter. While millet is harvested in August, sunflowers—the workhorse of the birdseed industry—are hardy and can stay in the ground until November or even longer.

CLEAN

Seeds are first treated on a shaker, and then a tilted platform called a gravity table removes sticks, weeds, and unwanted grains down to 2 percent or less of the material. Moist grains may also be treated with heat or air to ensure they don't mold or sprout in storage or packaging.

STORE

Grain can last a year or two in storage. Traditionally, farmers sell their harvest to regional grain elevators or grain-processing facilities that make their money adjusting prices depending on yields. Increasingly, farmers are building their own storage capacity to reap those rewards.

BLEND

At the factory, a giant rotating mixer blends seeds at the precise percentages desired. The different sizes and weights of birdseed ingredients make them prone to separating, but mixers are designed to ensure that every bag, from 2 to 40 pounds, contains the correct ratio.

WHAT'S THE DEAL WITH NYJER?

One common birdseed ingredient is conspicuously capitalized and tagged with the registered trademark symbol: Nyjer, or *Guizotia abyssinica*. What gives? Nyjer, a small, thin seed highly popular with finches, first arrived at U.S. feeders in the early 1960s as "niger"—pronounced like the nation of Nigeria—a foreign wonder seed that was 30 to 40 percent oil (on par with black oil sunflower seeds). Nyjer has often been misleadingly sold as thistle to associate it with the North American plant that finches frequent; to avoid any confusion, the Wild Bird Feeding Institute trademarked the seed as Nyjer in 1998. Today it is the only major birdseed ingredient primarily imported from outside North America—mainly from India and Ethiopia, where it's grown for oil and medicinal uses—and it risks carrying a noxious weed known as dodder. In the 1980s, dodder contamination prompted the U.S. Department of Agriculture to mandate heat sterilization for imported seed, and in the 1990s the rules became even stricter after infestations briefly halted the import of Nyjer. Currently, there are only four facilities in the world licensed to do the heat sterilization necessary to bring the seed to the United States: two in India that treat seeds before they're shipped and two in the mid-Atlantic that treat them when they arrive. There have been periodic attempts to develop a technique to grow Nyjer in the United States at commercial scale, but the seed is hard to harvest mechanically and the only U.S. market for it is birdseed, so those efforts have yet to turn a profit.

TIP!

Attract finches naturally with black-eyed Susans and other flowers in the daisy family. For more bird-friendly plant options, visit audubon.org/nativeplants.

U.S. AND CANADIAN CONSUMERS BUY MORE THAN 1 BILLION POUNDS OF BIRD FOOD EACH YEAR.

Four billion dollars buys a lot of seed, and yet it's safe to assume that most folks know little about where their bird food comes from. Almost all of the grain that becomes birdseed sold in U.S. stores originates in the Midwest and Canada, and the bag someone picks up at their local shop, home-improvement warehouse, garden center, or big-box store has traveled a long supply chain to get there. And the funny thing is that most of that grain wasn't grown for birds in the first place.

There are two important truths about the birdseed business. The first is that birds never get the first-rate grain. Thoreau threw out corn he planned to eat that had failed to ripen. In the Depression, birds got free, unsold, low-quality grain from local farmers; times were hard, and anything better went to people. Today, birds still generally get the lowest-quality portion of a crop, what's left after growers sell their best seed—that with the highest oil content, for example—for human uses like making sunflower or safflower oil. The second truth is that the grains in most popular mixes are commodities. Sunflower and safflower, millet and milo—they're all grown at massive scale and bought and sold for a wide variety of uses in global markets. Both of these factors help keep prices low and customers happy. Market research consistently shows that

PHOTOS FROM TOP: AGEFOTOSTOCK/ALAMY; XPIXEL/SHUTTERSTOCK

WHO LIKES WHAT

Why so popular? Black oil sunflower seeds have thin shells and oil-rich meat, which means less work and more energy.

From 2005 to 2008, the Wild Bird Feeding Institute contracted Millikin University's David Horn to conduct the most comprehensive scientific study of avian food and feeder preferences. Project Wildbird tracked 1.2 million feeder visits across North America to gauge interest in 10 common bird food ingredients. These were the top choices for a variety of feeder regulars and rarities.

	Black Oil Sunflower	Cracked Corn	Sunflower Chips (Fine)	Sunflower Chips (Medium)	Nyjer	Red Milo	Safflower	Striped Sunflower	White Proso Millet	Whole Peanuts
American Goldfinch	★		🏆	🏆	🏆					
Black-capped Chickadee	🏆		✓	★			✓	✓		
Blue Jay		★						✓		🏆
Cassin's Finch	🏆		★	★	✓		★	★		
Common Redpoll			🏆	🏆	🏆					
Dark-eyed Junco	✓	✓	★	★	★	✓			🏆	
Downy Woodpecker	✓		🏆	🏆				✓		★
Evening Grosbeak	🏆			★			🏆	✓		
House Finch	🏆		★	★	★		✓	✓		
Mourning Dove	★	✓	★	✓	★	✓	★	✓	🏆	
Northern Cardinal	🏆		✓	✓			✓	★		
Pine Siskin	★		🏆	🏆	🏆					
Purple Finch	🏆		★	★	🏆		★	✓		
Red-breasted Nuthatch	🏆		🏆	🏆				✓		✓
Red-winged Blackbird	★	★	✓	✓				✓	🏆	
Rose-breasted Grosbeak	🏆							★		
Song Sparrow									🏆	
Tufted Titmouse	🏆		✓	🏆			★	🏆		🏆
White-breasted Nuthatch	🏆		🏆	🏆			✓	🏆		🏆

Nyjer is popular with most types of finches, including the occasionally irruptive Pine Siskin and Common Redpoll.

Jays and woodpeckers will gladly gobble up peanuts in mixes or on their own.

Longing for gorgeous grosbeaks? Safflower mixed with sunflower seeds will do the trick.

Striped sunflower seeds are big and have a lower fat content than black oil seeds, making them less appealing.

Providing purely the seed meat without a pesky shell, sunflower chips are a hit with a variety of birds.

White proso millet is favored by many species of sparrows (and that includes juncos).

A BRIEF NOTE ABOUT MILO

A small, round red grain, milo is widely considered a filler seed, lacking any real nutritional value. It's also unpopular with most birds, which means the abundant leftovers can accumulate under feeders and attract unwanted pests. Avoid milo-heavy mixes when possible.

🏆 1st choice

★ 2nd choice

✓ 3rd choice

GRAPHIC: JULIE ROSSMAN/AUDUBON

cost is one of the top criteria for birdseed buyers and a key reason that people abandon the hobby.

Events over the past two years, however, have upended business as usual. Take, for example, the extreme drought that wiped out sunflower and safflower crops in the western United States in 2021. Or the sharp rise of fuel prices that sent the cost of transporting grain by truck through the roof. Or the ban on palm oil exports in Indonesia in April 2022, which routed sunflower seeds into a market hungry for other vegetable oils. Or the galloping inflation that has impacted virtually every part of the supply chain from farm to feeder. Add to *all that* a rising demand for birdseed products, and you've got a lesson in basic economics.

Opposite page: A cheery American Goldfinch eats from a mesh feeder (top) designed to hold the tiny, oil-rich Nyjer seeds (bottom) that the birds love.

MIXING IT UP

A quick primer on five common birdseed blends—and how they live up to the claims they make.

BIRD-SPECIFIC

NO MESS
High-quality mixes that include only seeds birds love, already removed from their shells. Without shells or filler seeds like red milo, everything in the mix gets eaten. Thus: no mess. These mixes deliver on their promise and have become increasingly popular with consumers who are willing to spend a little more.

ANTI-SQUIRREL
Seed blends treated with a chili-pepper-based coating that birds don't mind but that irritates determined squirrels and other feeder-crashing critters. Consider pairing with squirrel baffles or a squirrel-proof feeder for maximum deterrence—maybe.

BIRD-SPECIFIC
Mixes that predominantly include ingredients fancied by only one type of bird or a small set of birds. A classic example is a finch blend, which usually includes Nyjer and other fine seed fragments made specifically for the sock and mesh feeders that goldfinches and Pine Siskins prefer to hang from while eating.

BIRD-EXCLUDING
Blends designed to keep certain birds away, such as a mix heavy on sunflower seeds, which are difficult to open for European Starlings whose beaks are not adapted to cracking them. However, it's more effective to use different feeder types to exclude birds like starlings, which will happily eat safflower and milo seeds often included in these products.

HIGH-ENERGY
Blends that contain lots of nutritious ingredients high in fat or protein, like nuts, insects, and high-oil seeds. These mixes can be marketed as "winter blends," suggesting they provide birds with a needed boost. Supplemental food may be more valuable in the winter, but there's little evidence that birds' preferences change by season.

HIGH-ENERGY

ANTI-SQUIRREL

BIRD-EXCLUDING

"The cost has just continued to climb over the past two and a half years," says Rob Brunes, the director of bird food supply for Wild Birds Unlimited, a retail store with locations across the United States and Canada. But most consumers may not have even noticed. Brunes, who has nearly 30 years of experience in the business, says that when prices go up, major birdseed producers—knowing sales will plummet if the price of a bag of seed rises—will typically reduce stock or adjust the ratios of their mixes toward lower-quality ingredients, like milo or even oats.

Yet as price-sensitive as traditional seed buyers have always been, something curious has happened amid the tumultuous conditions of the past few years: A segment of consumers—new and old—has shown a growing willingness to pay more for premium products that may not just be better for the birds at their feeder, but also better for birds everywhere.

A couple of years before COVID-19 struck, Ken Dallmier was trying to persuade a bunch of farmers to convert their land for organic production. Dallmier is chief operating officer of Clarkson Grain, an Illinois supplier that specializes in organic corn and soy for human use, and Clarkson needed to recruit more growers. The problem is that there's an expensive three-year transition period for any farmer making the change. During that time, you must use organic practices but you're not yet certified, so you can't charge organic's high premium to help cover the associated costs. Dallmier hit on an idea: If the farmers grew sunflowers—a crop known to produce well in the region—he could market their seeds as pesticide-free, eco-friendly birdseed. He figured people who feed birds and care about the environment would jump at a product that aligned their hobby with their values.

So Dallmier started a birdseed company, and by early 2019, Prairie Melody birdseed was available on Amazon. The product cost more than a bag of conventionally grown seed. Sales grew anyway. And when the pandemic hit, Prairie Melody flew off the shelves. In the summer of 2022, orders overtook the capacity of the transitioning farmers, and the seed briefly sold out. Dallmier's hunch seemed to be right. There was demand for a new kind of product, one that's good for birds in a larger, more ecologically minded sense. "It may not be for everybody, and that's fine," he says. "But there's a significant number of people who care about the environment."

Some birdseed buyers worry that the seeds they are feeding birds are laden with pesticides. While pesticides are used on many of the crops commonly found in birdseed products—either before or after they are planted—there's currently no indication that the harvested ingredients used for bird food contain enough

PHOTOS: LUKE FRANKE/AUDUBON

chemicals, if any, to pose a risk to feeder birds. But concerns about pesticides and birds are not unfounded. As studies on a class of pesticides called neonicotinoids have shown, birds can be exposed to harmful chemicals in fields where treated seeds are used, and pesticides have indirect effects, too: damaging insect populations and the ecosystem that birds rely on. Organic farming helps mitigate these threats and the industrial-scale practices that can knock ecosystems out of balance—for example, by flushing excess nutrients from synthetic fertilizers into rivers, creating ecological dead zones.

David Horn, a biologist at Millikin University in Decatur, Illinois, is perhaps the foremost scientific expert on birdseed products. He has spent his career answering the big questions of bird feeding: Which species most frequently visit feeders? Who likes what? Does *anyone* like milo? Because of his expertise, Horn has also long been a consultant to birdseed manufacturers. He believes that, as the hobby has matured and consumers have the opportunity to become more aware of product quality, higher-oil seeds and organic or eco-friendly options have lots of sales potential. “I definitely think there is a market for more premium seed,” he says, “whether that is premium in terms of their nutritional value to birds, or whether that is in terms of being grown in an environmentally friendly manner.”

For his part, Brunes of Wild Birds Unlimited says that customers “absolutely” ask about organic products and have for some time. The company tried selling organic seed 20 years ago and again 10 years ago, but never managed to do it profitably. Brunes thinks that after the grain industry shakes off the effects of the pandemic on supply chains and seed reserves, Wild Birds Unlimited might try again.

BIRDSEED MIXES AND EVEN THE EQUIPMENT TO MAKE THEM ARE PROPRIETARY AND HIGHLY GUARDED INDUSTRY SECRETS.

TIP!

Avoid paying a premium for higher-end mixes that include insects by buying bags of dried mealworms and adding them to your favorite birdseed blends.

Some people are trying now. Matthew Brimer, his fiancée, Whitney Frances Falk, and their friend Stetson Hundgen cofounded the organic birdseed company Flying Colors in 2020 when they struggled to find organic seed options. The trio created their product, which comes in a recyclable carton, with their friends and peers in mind—millennials who reached adulthood amid the climate crisis and now have homes and disposable income. But as they quickly discovered, their product appealed to people of all ages. Brimer says their goal was to provide a “premium, thoughtfully created, scientifically backed product,” but he calls it, more simply, a “modern-day birdseed brand.” It, too, seems to have struck a chord; website sales for the cartons have grown, on average, 30 percent a month since last May.

These are early days, but the enthusiasm that Prairie Melody and Flying Colors have seen is promising. Considering how large the birdseed industry is, though, organic and eco-friendly products will likely always be a sliver, one of a variety of offerings meant to serve all types of consumers. For the industry, that’s just smart business. And for birds, the more folks involved in the hobby, the better: People invested in seeing wild birds thrive are also likely to advocate for their protection. Indeed, the bond we develop with the birds that visit our feeders is deep and powerful. Reflecting on the lessons of three years of supercharged growth in a time of human calamity, Dallmier believes the lesson is simple. “We don’t feed birds because they need us,” he says. “We feed birds because we need them.” Ⓐ

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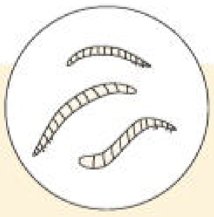
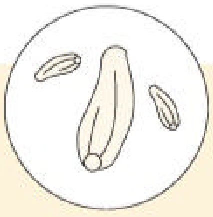
TREND-SPOTTING

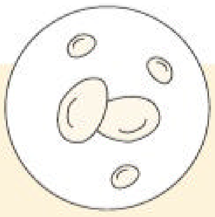
A look at what’s happening now and what may be on the horizon.



INSECTS
As more premium options have come on the market, protein-packed insects like mealworms and black soldier fly larvae are being added to mixes to attract insect-loving birds. Mealworms can be more expensive than seeds, so they tend to be in higher-end mixes that include only oil seeds, nuts, and fruits.



NUTRASAFF
Also called golden safflower, this is a seed developed and exclusively sold by Safflower Technologies International, originally for human use. In 2008 STI began touting the seed’s thinner hull and higher oil content for use in U.S. birdseed. Birds love the stuff, but its spread has been slow so far.



HEMP SEED
Lauded as bird food as early as the 19th century, oil-rich hemp seed fell out of favor in the United States beginning with the Marihuana Tax Act of 1937. But the 2018 Farm Bill made hemp, a class of cannabis, once again a legal (if heavily regulated) crop. Blends in Canada and Europe already use hemp seeds in mixes.

GRAPHIC: JULIE ROSSMAN/AUDUBON

IN SEARCH OF AUWO

The Black-naped Pheasant Pigeon, a unique bird of Papua New Guinea, hadn't been documented in more than a century. Now a team had a month to find one—and to do so, they knew they needed help.

BY JASON GREGG
PHOTOGRAPHY BY JOHN C. MITTERMEIER

A deck of cards includes an ace—the bird known locally as Auwo. Researchers hope an island resident will recognize their target.

IN THE SMALL SEASIDE village of Basima, a hunter leans forward and taps a card showing an illustration of a bird. He's seen that species, the Metallic Starling, known locally as Bune wiwi, here on Fergusson Island in eastern Papua New Guinea. Carefully he taps another card, the Goldie's Bird-of-Paradise, or Siai, which is found only on this archipelago. And another, and another. Children peek at our group of strangers, who'd arrived yesterday and set up a makeshift camp.

There are 25 cards, each showing a different bird. Some obviously don't live here, like the Northern Cassowary, a flightless, five-foot-tall avian giant. Others are common residents that inhabit the village's periphery or the forests where Fergusson Islanders hunt for food and harvest housing material. There are also more challenging cards—look-alikes of local species and small birds only an experienced observer could identify.

Finally, there's an ace card mixed in: the Black-naped Pheasant Pigeon, with its wide eyes the color of blood, stilted yellow legs, cadmium-orange wings, and a long, tent-like tail. When the hunter pauses over this card, time slows down. Now and then, I exchange glances with our guide and translator, Elimo Malesa, and one of my expedition co-leaders, Jordan Boersma. Will the hunter choose it?

The Black-naped Pheasant Pigeon is the strange bird that has drawn us to this small tropical island. A large, poor-flying pigeon with a pheasant-like tail, it's the rarest of four sister species of pheasant pigeon scattered across New Guinea. But even calling it rare may be generous: Scientists haven't laid eyes on it, or heard its far-carrying song, in more than 100 years. Our eight-person team has come to Fergusson Island, the only place it's thought to live, to seek it out.

I knew we could easily fail. Islands like Fergusson are sites of more than 90 percent of bird extinctions, where naturally small avian populations succumb to introduced predators, disease, and habitat loss. And studies show morphologically distinct species, like the pheasant pigeon, are at highest risk of blinking out. But there were reasons for hope. Fergusson Island is mostly roadless and covered in excruciatingly steep mountains, which is likely why few scientists have come here since Scottish naturalist Andrew Goldie first collected the species in 1882. A handful of specimens and a 140-year-old paper describing the bird are the source of all we know about it. There's also its behavior: Pheasant pigeons are highly secretive. Perhaps it's been here all along.

Top: Fergusson Island's rugged north coast, or "Back Page" as it is called locally, photographed by a drone from Basima. Bottom: Trekking after the pheasant pigeon requires navigating rivers and difficult terrain; the team also uses that time to survey the island's many other birds.

John C. Mittermeier is optimistic. He's the director of the Search for Lost Birds at American Bird Conservancy (ABC) and another expedition co-leader. The Search for Lost Birds, a collaboration among conservation nonprofits ABC, Re:wild, and BirdLife International, has cataloged around 140 "lost" birds globally, defined as species undocumented with visual or audio recordings for at least 10 years. John says that about 20 species have been missing in the scientific record at least a century. Of these, he believes just a handful have dodged extinction and have a shot at being found—including our target.

Foreigners don't regularly come to Fergusson, and it's crucial we gain the trust of residents, who are cautious of our arrival. Throughout Papua New Guinea, Indigenous people own and manage almost all land, and without their buy-in, we won't be allowed to step foot into the bird's forest habitat. To introduce our project—and hopefully start a flurry of conversations that may help our search—our plan is to give presentations in communities, beginning at Basima's primary school. Uniformed students sitting in neat rows in the shade of a mango tree listen as we describe the pheasant pigeon's appearance and call. "Your homework is to look for the bird," announces principal Eric Nungu, with a glimmer of a smile. A shy fourth-grader who lives on a ridge above Basima comes to tell us he may have heard it. He'll go speak with his parents.

Our best leads, however, are likely to come from the island's hunters, who are most familiar with its wildlife. Interviews with them form the backbone of our month-long search. We hope they'll recognize our ace card and guide us to spots to deploy motion-activated cameras and automated sound recorders, gadgets we've brought to capture evidence of the bird and invasive mammals that may live here. The cameras are our sentinels: They eat batteries, stay up all night, and document everything in their path. The recorders listen for the pheasant pigeon's distinctive song, described in writing "as a sort of *ké-o*, the 'o' being prolonged."

After striking out with the first hunter we meet, Jordan and Elimo talk with another in the shade beneath our raised guesthouse. The man, who has lived on Fergusson his whole life, tells us he's been hunting since he was a boy. He goes into the forest two or three times a month, staying out overnight if the weather is fine, and he recognizes most local birds we show him. He hasn't seen the pheasant pigeon, either.

As the week unfolds, more interviews yield similar results. Basima's hunters are bird experts; they choose the right cards, avoiding species that aren't here. Still, no one recognizes the missing bird, and doubt ripples through our team. But we're not giving up yet.

MY WORK ON FERGUSSON Island began in 2019. Electrified by the chance to do research in New Guinea, I followed Jordan and Doka Nason, a skilled Papua New Guinean biologist, to scale a toothy mountain named Oya Nai and survey birds. For 10 days we lived on rice, canned tuna, and local fare like ferns, beetle grubs, and freshwater eels, and our surveys documented range expansions of five birds not formerly known to live there. Our results were a strong indication that the island's avian communities were understudied by scientists. As we surveyed the mountain's primary forests, I expected we would eventually come across the elusive Black-naped Pheasant Pigeon, and hunters seemed to recognize the species in our field guides. But by that trip's end, we never saw or heard the bird.

New Guinea is the largest tropical island on Earth, and Papua New Guinea is the country that occupies its eastern half. Its western half is part of Indonesia, a division that is a legacy of the island's colonization. After the Amazon and the Congo Basin, New Guinea hosts the most extensive unbroken tract of tropical forests in the world. Because it has been separated from the Eurasian continent for tens of millions of years, no hoofed mammals, felines, or nonhuman primates are native to the island. But an extraordinary cast of marsupials and singular birds abound. Nearly 800 avian species are native here, such as pitohuis and Blue-capped Ifrita, which wear an invisible shield of poison on their feathers and skin, and birds-of-paradise, whose breeding displays tranform them into color-dripping hallucinations.

Even among this biodiversity, birds like the Black-naped Pheasant Pigeon stand out—both for how little scientists know about them and because they exist nowhere else on Earth. New Guinea's main island is adorned with dozens of smaller fringe islands such as Fergusson, biodiversity hotspots influenced by the larger mothership. "They're mini New Guineas," says ornithologist Bruce Beehler, "the seeding grounds for insular speciation." Birds show up from the main island, establish isolated populations, and evolve into distinct species over time. The Black-naped Pheasant Pigeon is a prime example.

EVEN AMONG THIS BIODIVERSITY, BIRDS LIKE THE BLACK-NAPED PHEASANT PIGEON STAND OUT BECAUSE THEY EXIST NOWHERE ELSE ON EARTH.

When I descended from Oya Nai's rain-drenched slopes, I returned to tragedy. While I was out of phone service, my little sister had died, cutting off our laughter and initiating a dimmer, second life. I left Papua New Guinea in catatonic grief, relocated to a new job, and attempted to hold a steady bearing. Conservation was my beacon. On a Hawaiian island nearly the size of Fergusson, I joined the ranks of determined biologists fighting for ecosystems pushed to the brink. Working to help endangered species, I listened to the eerie silence of a forest devoid of native songbirds for which help was too late. Loss was a warning, and the pheasant pigeon's absence lingered on my mind.

What does it mean for a species to be lost? Unlike rare birds of Hawai'i, which have been a focus of long uphill conservation battles, the Black-naped Pheasant Pigeon's status was a big question mark. At the time of our first trip to Fergusson, the International Union for the Conservation of Nature (IUCN) classified it as endangered, but this was a rough sketch based on little ground-truthing. Our own failure to spot it further suggested that any population, if one survived, was likely very small. Doka, Jordan, and I sounded the alarm in a peer-reviewed paper, recommending an island-wide search. In response, the IUCN elevated the bird's extinction risk level to critically endangered. When John at ABC contacted me, it was a catalyst. His program had a funding opportunity: Would we like to plan an expedition?

We assembled a first-rate team: half international, half Papua New Guinean. Jordan, now a postdoctoral researcher at the Cornell Lab of Ornithology, and Doka were both on board. We'd be joined by John, who has been obsessed by lost birds since age 12, and Cosmo Le Breton, a young Oxford University biology student who funded the trip. Bulisa Iova, principal curator at Papua New Guinea's National Museum and Art Gallery, and Serena Ketaloya, who has worked on conservation and gender equality projects across the region, rounded out our group. And after a few Whatsapp messages, Elimo, whom we'd first met in 2019, signed on to be our guide and translator.

Our guide has two names—Elimo, his Christian name, and Weluwa, the name given by his clan—and his life bridges two places, separated by 50 miles of reefs, mangroves, and open water. In Alotau, a bustling capital city in eastern Papua New Guinea, he's starting a renovation business. But he still considers Fergusson home. He has recently become leader of the Mwadiawa, or White Cockatoo, clan. He's a natural orator who speaks six of the more than dozen local languages on Fergusson and knows the island like the back of his hand, including where to find a touch of cell phone signal and fuel for our boat, as well as where it's safe and what villages are best avoided.

From afar, Fergusson looks like a mountain fortress, but I learn that the rural island where Elimo grew up isn't isolated. Local elections feature ranked-choice voting, and though electricity is scarce, music traded on SD cards and flash drives tinkles through villages. People are always on the move, traveling to other islands—and as Elimo and his father, Fred, explain, this region hosts a traditional trading system of shell necklaces and armbands called the Kula Ring that has connected these communities for centuries. However, Basima is on the coast facing away from the rest of Papua New Guinea,which is why locals call the area the Back Page. People here, I learn, crave better access to markets, information, and goods. A recent political campaign featured a T-shirt that read, "Make Esa'ala District Front Page Again."

I'd come to think that if hunters here knew the Black-naped Pheasant Pigeon, it wasn't lost in a real sense. Colonial narratives of discovery still saturate Western representations of Papua New Guinea, explains Paige West, a Barnard College and Columbia University anthropologist who has worked in the country over many years. Away from

Clockwise from top left: At his family home in Basima, Elimo Malesa displays a traditional decorative shell necklace; Augustin Gregory guides the group to ideal spots on his land to look for the bird; Serena Ketaloya hikes into the forest near Duda Ununa; biologist Doka Nason is at home on the trail.

academic journals, reliable and affordable internet, and tools like binoculars and cameras, lostness was a misnomer, I realized, a result of a continued centering of natural history and ecology in the West.

In searching for the pheasant pigeon, then, our task was to link expertise on Fergusson with our own, testing opportunities for collaboration, an approach John tells me is key to the Search for Lost Birds strategy. Our team member Serena adds: “Local knowledge is very important because people in the communities live with nature. They live with what is around them, they live off the forest, they live off the sea.” Their survival, she says, relies on this knowledge.

On Fergusson, Indigenous landowners coordinate and watch over our search, and hunters know their forests best. Yet with no leads, we form a plan: travel by boat to the other side of the island’s main mountain range and try our luck there.

THE MOUNTAINS TRANSFORM kaleidoscopically with the shifting angles of our boat as it hugs south Fergusson’s palm-lined coast. After long days on foot, passing miles over water is like magic, and once we relocate, our interviews gain traction. A local name for the pheasant pigeon, mentioned in passing already, crystallizes: Auwo. Then a hunter tells us he caught one in a leghold trap in 1997, before loggers pushed the bird deeper into the forest. An older woman, Soama Lambert, even recounts her grandmother meeting Goldie in the 19th century—assurance we’re in the right area.

From top: The team’s camp near the Kwama River; Jordan Boersma plays recordings to landowner Moses Gali to learn about local birds. Opposite: The expedition records two pheasant pigeons, one in a photo (shown) and one on video. View footage at audubon.org/auwo.

We meet a hunter in the Buidoa clan, Paul, who says he saw a pheasant pigeon earlier that year. His father had described the species to him—how it flew, its shape, its colors. “My father told me, ‘When I die, you cannot leave this mountain. There are some good things here,’ ” he says. So when Paul saw the bird, he knew: Auwo.

Jordan and Elimo split off to interview others, while Paul guides the rest of us up the mountain. He wears a baseball cap and carries a double-edged pig spear, its shaft crafted from black palm. We make camp in his recently cleared garden, where he will soon plant yams, pineapple, and other crops, and Paul says he’ll take us to where he encountered the bird. “We might have good luck because this morning I dreamt very good dreams,” he says. On the narrow trail, one of his several hunting dogs brushes against my calf. The dogs make me nervous: Losing a rare pheasant pigeon to an eager pup would be a disaster. Trailing him, Paul’s young son carries a six-foot-long rubber gun—a kind of slingshot on steroids—that he weaves deftly through the understory. Doka, John, and I, hunters from a parallel universe, wield binoculars, smartphones, and a pack filled with camera traps.

As we gain elevation, the ridge sprouts creeping bamboo and pandanus, a plant with serrated, frondlike leaves. Paul explains that harming the pandanus brings foul weather, folding a leaf carefully back on itself. I do the same. Suddenly, we drop again, fanning out like a search party, hoping to flush a pheasant pigeon up into a low branch.

Paul picks up a shiny red fruit from the forest floor. “Buo’o,” he says—fruit the Auwo eats. Ahead, Serena gathers leaves from a giant stinging nettle, called the itchy plant, that many here use to fight aches and pains. Doka spots an owl. Crows with blue eyes shriek above the canopy. But no one sees or hears a pheasant pigeon. The day is waning, the terrain is painfully steep. We set up our cameras before a prolonged slog home.

Back at camp, Jordan and Elimo return with great news: Two hunters they interviewed reported seeing a pheasant pigeon recently. The next morning we break camp and depart at first light to chase the lead, and Jerome, Paul’s uncle, waves goodbye. He shared with us a chant about the pheasant pigeon and explained how its feathers were once collected and worn. A leaf from the itchy plant rests atop his head like an arrow, seemingly pointing us in the right direction. Our boat is leaving Fergusson in five days. It’s our last chance.

Everyone is excited as we march up the valley, and we unwind on the trail. Trekking also lets us survey for birds while on the move, and we’ve already documented

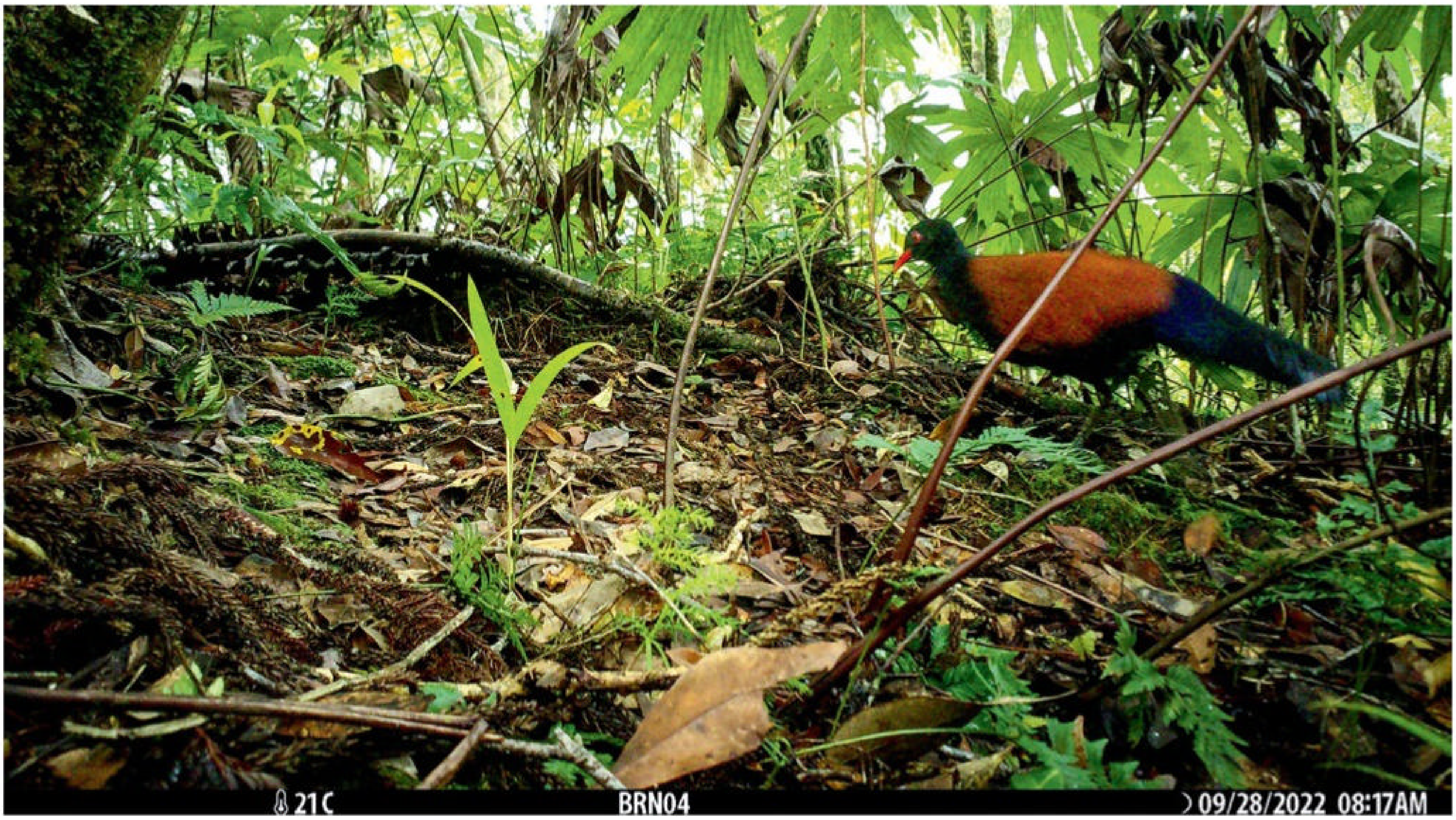


PHOTO: DOKA NASON/AMERICAN BIRD CONSERVANCY

at least seven more species not previously known to occur on Fergusson. After hours of hiking and river crossings, we're tucked into the back of the valley in a place called Duda Ununa, where we'll camp. Massive Papuan Hornbills transit the sky in fading light. Jonathan, leader of the Manawana clan, tells us that Auwo is here.

Augustin, his brother, agrees to guide us the next morning. With bushy eyebrows and often sporting a pipe, Augustin is in his late 40s and sprints barefoot through the forest like a phantom. He describes the pheasant pigeon in high resolution: its bill and eye color, where it sleeps and eats, and the way it pumps its tail as it walks.

> THE TINY SCREEN SUDDENLY AND UNMISTAKABLY SHOWS ME EVERYTHING I THOUGHT WAS OUT OF REACH.

We move deeper toward the island's center with Augustin, and the landscape heaves into bunched-up ridges with steep drops on either side, topography that John likens to origami. Klinki pine tower above us, conifers with giant, flaky trunks that balloon into the tallest trees in New Guinea. We make camp along the Kwama River, and on our second fruitless day we get lost—buried in a valley and surrounded by walls of thick, wet forest. When we finally find camp, we're exhausted, and Augustin decides we'll head back a day early. Just like that, our field season is over.

THERE IS A PARTICULAR FEELING to looking for something you're not sure exists—cautious doubt tinged with absurdity and an edge of sensory alertness—that amplified on Augustin's land. His and others' knowledge of Auwo is convincing, but we've reached this critical juncture too late. Without hard evidence or at least a sighting, it will be impossible to prove to science journals and conservation inventories that the bird survives.

Packing up, Jordan and Doka climb a ridge to retrieve cameras they'd only recently placed with Augustin's guidance, returning with the same weary disappointment that's swept over everyone. Handing me a camera, Jordan says I may as well look through it before we descend.

I scroll, and I freeze. The tiny screen suddenly and unmistakably shows me everything I thought was out of reach: Auwo, long-tailed, walking in dappled green light beneath umbrella ferns. Unquestionably, vividly, most certainly alive. "It's so beautiful," I say again and again, my hands shaking as I stare in wonder.

Jordan and Doka break into cheers—they'd seen the image earlier, too far off for us to hear their shrieks of surreal joy. Everyone gathers around the camera. Elimo stands slightly aside, quieter than the rest. "Man, it's like a burden has been lifted from me," he says, slowly offering a smile. The full weight of the trip reveals itself.

Though we don't know it yet, another camera has triggered closer to Basima, capturing a second pheasant pigeon—this one on video. No one on our team has set eyes on the elusive bird, but the footage lets us appreciate Auwo in all its glory. The bird in the clip is luminous and quick-footed, its tail pumping vigorously with each step.

In late 2022, a couple of months after our return, Re:wild and ABC announce we found the pheasant pigeon, and the story explodes. Social media and news reports send the camera-trap video of the bird, along with Doka's ecstatic reaction to seeing it, to millions of viewers. I catch sight of the story in many languages. Suddenly, this obscure bird, Auwo, is known around the world.

BEFORE WE LEFT FERGUSSON, Jonathan had shared a legend about the pheasant pigeon, which Elimo translates. Auwo was once a woman. She worked hard all day in her family's garden, but when she returned home, her family offered her only plain food while they ate dishes made with coconut cream. This went on until, hurt by her mistreatment, she ran away. From her coastal home, she fled into the mountains,

Continued on page 55

Our primer on avian abodes.
Plus: Take in the waves of migration.

Bushtits build elaborate, hanging nests out of soft materials like spiderwebs, mosses, and lichen.

It’s Nesting Season

Observed from a safe and respectful distance, nests offer a window into overlooked bird activity all around us.

PHOTO: DAVID MOSKOWITZ

TAKE IT FROM ME

Watch Nests to Bird Better

Casey McFarland, author of *Peterson Field Guide to North American Bird Nests*, describes how a bird's nest reveals its experience of the world.

ONE SPRING, I WAS TAKING A WALK ON a clear morning in western Washington, when a Chestnut-backed Chickadee startled me. She had alighted on a branch just a few feet from my face. After a moment of hesitation, she flitted toward me and, clinging to my chest, began to pull at the woolen fibers of my raggedy sweater. I held my breath. She fluttered to my head and tugged curiously at my hair. The prickling of her delicate claws on my forehead finally made me burst out laughing, and she shot back into the woods, bits of sweater and hair in her beak.

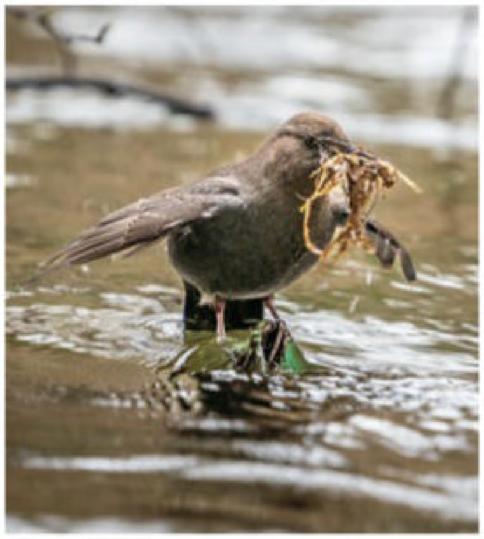
Across the United States and Canada, from the boreal north to Floridian bottomlands, chickadees nest in cavities lined with a soft mattress of mammal fur. That morning, I was the source. At the time, I had no idea what chickadee nests looked like or where they were built. For the first time I wondered. Now, more than 20 years later, I reflect on that experience with a new perspective. I've come to appreciate how nests tell extraordinary stories about their makers if you learn how to read them.

Nests teach us how birds think. In a single stretch of forest, Bushtits are experts at finding silk and egg cases from countless spiders with which they build stretchy, socklike nests. A robin finds a mud source to create a clay bowl for her nest's rigid inner cup. American Dipper nestlings hatch into a ball of green moss built at the edge of a pounding mountain river. And young kingfishers are raised in the darkness of an earthen burrow masterfully excavated by their parents' oversize, fish-spearing beaks. Each species is hatched onto the same landscape but in entirely different settings, and each of their views of the world is richly varied from the start.

Consider everything mature birds know. The local environment, certainly. They also know other animals that live nearby: black bears, deer, elk, mountain lions and coyotes, woodpeckers and Cooper's Hawks—a whole community of life. Some species, like my chickadee, may be year-round residents, experiencing their corner of the world from golden summer to the deep cold of winter. Others are migrants who traverse continents. Theirs is an ecological knowledge that spans vast stretches of the planet.

Each nest is a map of one bird's experience on Earth. It relays how a particular bird sees the place it's raising young, what materials it looks for, and the location it prefers. And for the many species that fly south for the winter, perhaps to the forests and fields of Mexico or Brazil, the empty nest we find on a cold January day connects us to another part of the planet—evidence in our own backyard of an individual who may, at that very moment, be preening contentedly on a tropical tree branch some 3,000 miles away.

Twenty-odd years ago, I happened to be part of a chickadee's map. In a tiny way, I was part of her nest, and that experience is now part of my map of the world.



American Dippers (top) build globular nests on cliff ledges or streamside boulders. Belted Kingfishers (bottom) dig burrows three to six feet long in riverbanks.

PHOTOS FROM TOP: DAN STREIFFERT/AUDUBON PHOTOGRAPHY AWARDS; LINDA FRESHWATERS ARNDT/ALAMY

ETHICS ALERT!

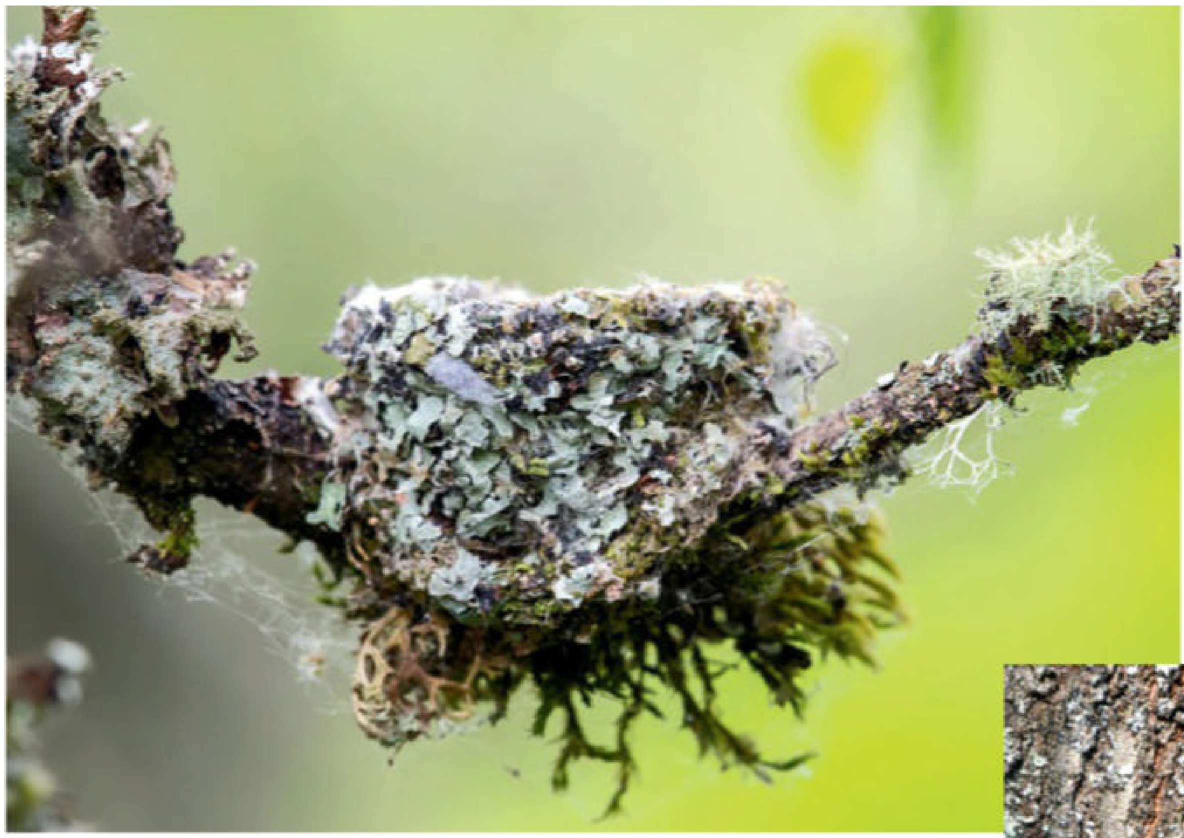
Approaching active nests can draw the attention of predators or disturb young birds. Keep your distance and watch through binoculars. Delay close study until long after the inhabitants have left for the season.

PRO TIPS

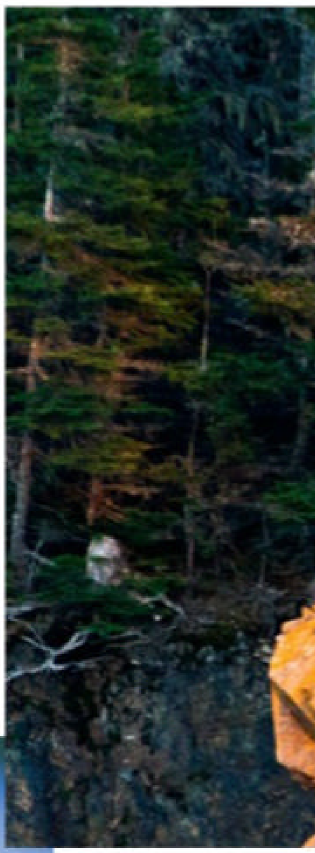
House Hunter

In spring, most avian activity revolves around nesting. Tune in to behavior to locate birds' hidden homes.

- A singing male typically patrols the border of his territory after mating. Somewhere nearby, often behind and below the male, a female sits quietly atop her eggs.
- Birds carrying nesting material may point the way to their hideout. They are wary and will frequently perch nearby to survey the area. Once satisfied that all is well, birds will often beeline to the nest.
- The same is true for birds carrying insects, since they're on their way to feed young. A bird perched with a bug in its beak is usually close to the nest. If you're patient, it will show you where it's headed.
- A bird cautiously emerging from thickets or tree canopy, and then darting off with purpose, is likely leaving the nest. You may see it drop a fecal sac on its way out. —*C.M.*



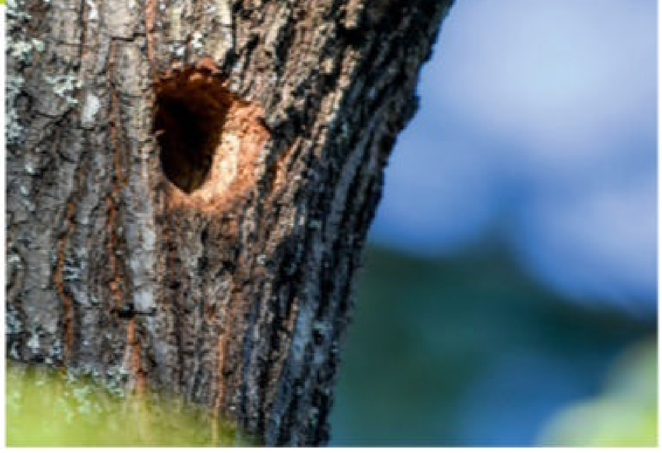
This delicate nest, just 1.5 inches wide, is crafted by a female **ANNA'S HUMMINGBIRD**. It's made with downy materials like cattail and feathers, bound in spiderweb, and decorated with lichen. *Other artists of very small cups*: gnatcatchers, Least Flycatcher, and Cerulean Warbler



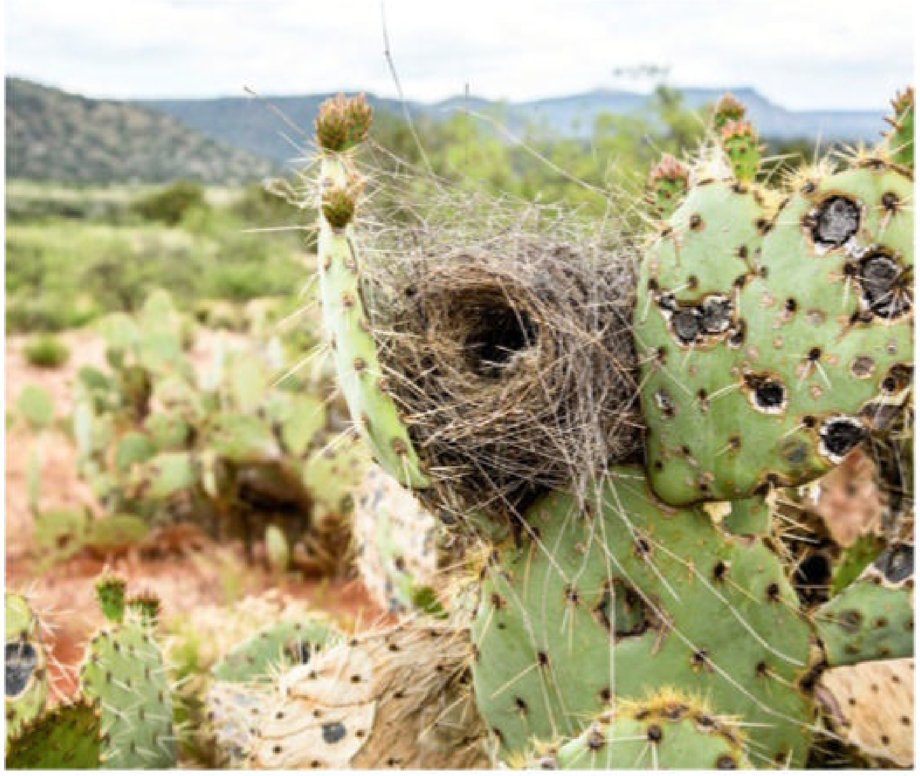
GALLERY

Avian Architects

Birds build an amazing variety of nest types, and each construction is a work of art.



HAIRY WOODPECKERS hammer out cavities in the soft wood of a snag or a living tree with fungal heart rot. The entrance is just two inches wide, but leads to a cavity up to a foot deep. *Other cavity nesters*: bluebirds, nuthatches, and chickadees



To hide from the sun, **CACTUS WRENS** build a roof over babies' heads. Twigs and dried grasses form the walls and feathers line the inner chamber. *Other crafters of globular nests*: magpies, Verdin, and American Dipper

INVESTIGATE

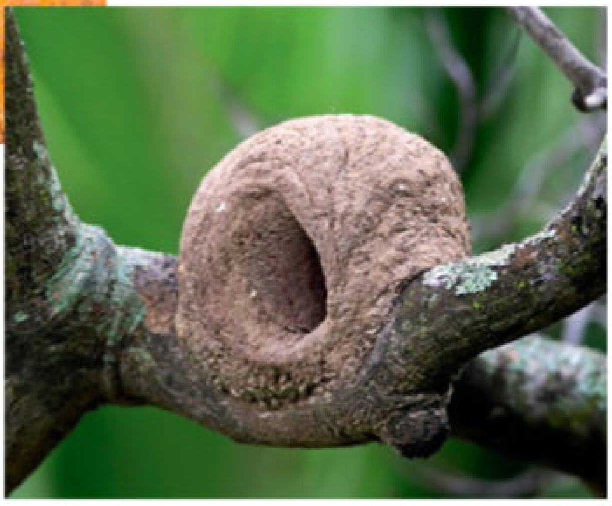
Clutch Details

Up close, appreciate nests' magnificence.

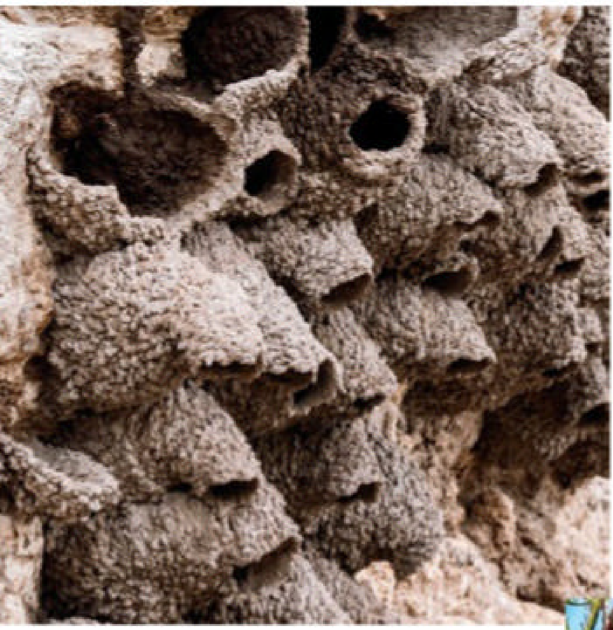
WHEN YOU HAPPEN ACROSS AN OLD BIRD NEST (after young have fledged), play detective to learn what you can about its maker. Try to determine the structure's layers, if they're present and distinguishable: an outer and inner cup, a delicate lining, a decorative covering. Ask yourself what materials each layer is composed of and from where, or whom, they may have been gathered. How is the nest held in place? Where is it tucked on the landscape? These details bring you closer to deducing who may have built the nest. You can expedite your identification skills by familiarizing yourself with a few local species—the nests' typical designs and where they tend to be placed. The more you intentionally look for nests, the more you'll realize they're everywhere. —*C.M.*

PHOTOS CLOCKWISE FROM TOP: MICK THOMPSON; LIA BOCCHIARO/AUDUBON; DAVID MOSKOWITZ

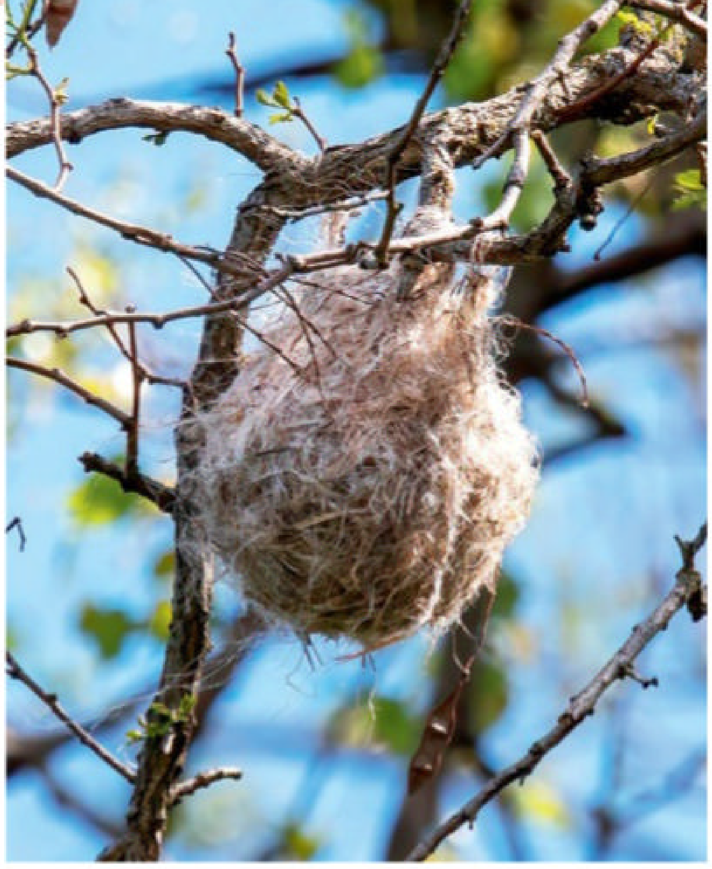
◀ **OSPREYS** pile sticks and branches on ledges, treetops, and poles, then line them with moss, algae mats, and dried seaweed. If reused several years in a row or even for generations, their nests can grow as big as 6 feet wide and 12 feet deep. *Other builders of large stick nests*: egrets, herons, eagles, and storks



▲ The neotropical ovenbird family is named for the nest of the **RUFOUS HORNERO**. They mold rock-hard "ovens" from clay, mud, and straw and line them with grass. *Users of vacant ovens*: swallows and flycatchers



▲ **CLIFF SWALLOWS** nest in colonies of hundreds or thousands. They gather mud to form pellets in their bills and sculpt nests by placing one pellet at a time. *Other mud-cup nesters*: Black and Eastern Phoebes



▶ This hanging basket belongs to a **BALTIMORE ORIOLE**. A female gathers long threads, such as grasses, hair, and Spanish moss, and weaves them. She lines the nest with cottonwood or willow. *Other hanging-nest weavers*: kinglets, vireos, and Bushtit

PHOTOS CLOCKWISE FROM TOP: JENNIFER BOOHER/ALAMY; JURGEN AND CHRISTINE SOHNS/MINDEN PICTURES; KAREL BOCK/ALAMY; JANET HORTON/ALAMY

ASK AN EXPERT

What should I do if I find a nest where it doesn't belong?

Sometimes birds nest too close for comfort. It's not uncommon to see Mourning Doves in an air-conditioning vent, Eastern Phoebes on a windowsill, American Robins in a wreath, or House Finches in flowerpots.

LEAVE IT BE. If you find a surprise nest, let it be. "You're not supposed to mess with it," says avian ecologist Caren Cooper from North Carolina State University. The Migratory Bird Treaty Act, a federal law, protects roughly 1,100 native migratory species. Be patient, Cooper says; young fledge about a month after egg laying. During this time, hang a warning sign and keep cats indoors.

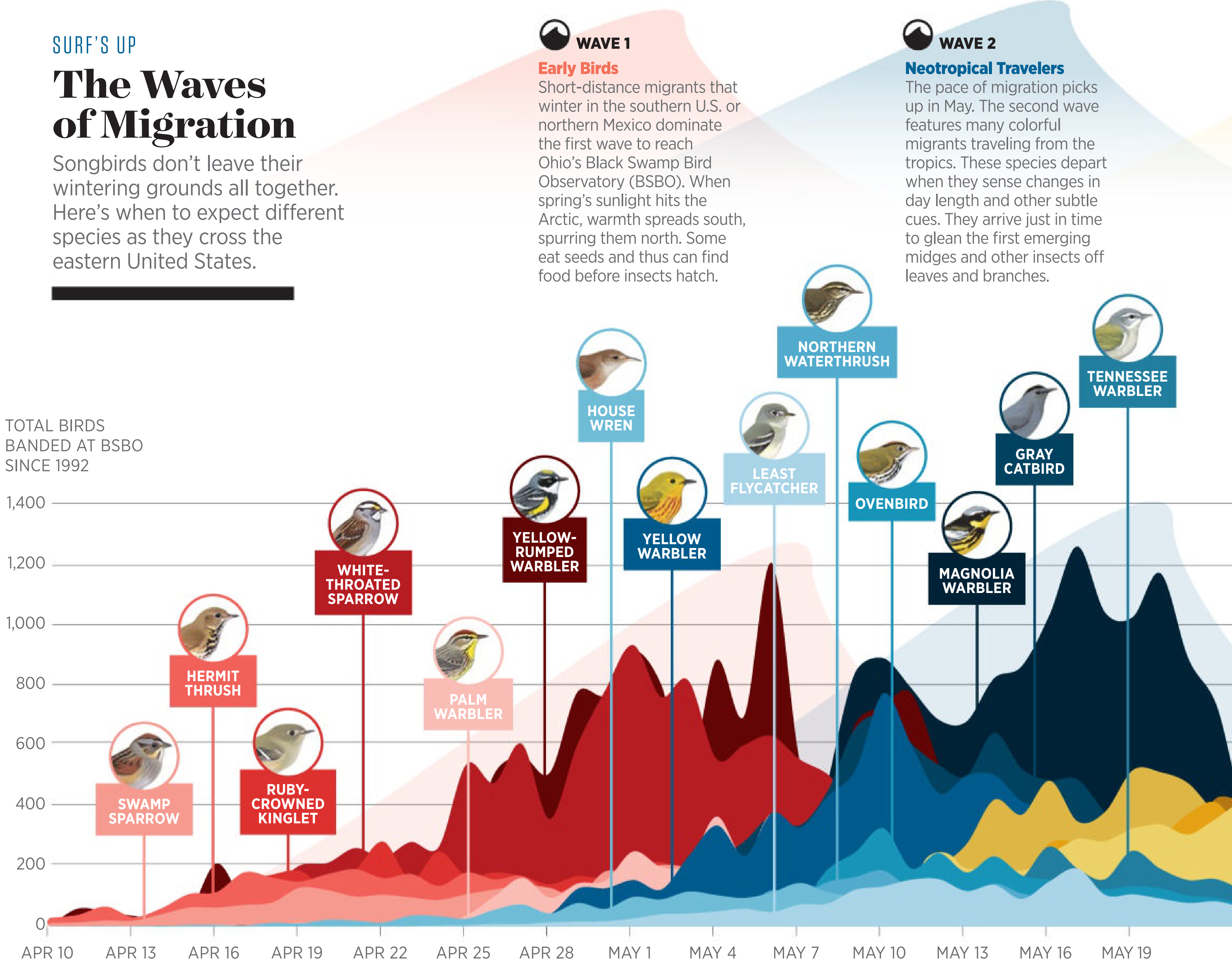
CALL AN EXPERT. Sometimes, a nest's location is unsafe—for example, in a tailpipe or gravel driveway. In such extreme cases, call a wildlife rehabilitator to relocate it, says biologist Robyn Bailey from NestWatch, a nest-monitoring program by the Cornell Lab of Ornithology. "Often those nests are so delicate that you're going to damage the nest and any eggs or young in it."

HANG NEST BOXES. Birds love to nest in dark crannies, even setting up house in a little-used baby stroller or bike helmet. To encourage better choices, hang nest shelves or boxes to lure birds to safer areas. If they take you up on it, consider helping scientists study nesting behavior by joining programs like NestWatch (nestwatch.org). And, of course, enjoy watching parents bring up chicks from a distance. —*Spoorthy Raman*

SURF'S UP

The Waves of Migration

Songbirds don't leave their wintering grounds all together. Here's when to expect different species as they cross the eastern United States.



WAVE 1

Early Birds

Short-distance migrants that winter in the southern U.S. or northern Mexico dominate the first wave to reach Ohio's Black Swamp Bird Observatory (BSBO). When spring's sunlight hits the Arctic, warmth spreads south, spurring them north. Some eat seeds and thus can find food before insects hatch.

WAVE 2

Neotropical Travelers

The pace of migration picks up in May. The second wave features many colorful migrants traveling from the tropics. These species depart when they sense changes in day length and other subtle cues. They arrive just in time to glean the first emerging midges and other insects off leaves and branches.

AFTER BIRDING SEVERAL SPRING migrations on the East Coast, you might notice patterns. Species don't show up in April and May all mixed up in an avian potpourri; instead, they tend to pass through in a predictable order year after year.

No one knows this better than banders at Ohio's Black Swamp Bird Observatory (BSBO). Situated on Erie's lakeshore, BSBO is one of the last places migrants can rest before crossing the Great Lakes for breeding grounds in Canada. When they alight to refuel, some hit mist nets. Trained experts remove birds, take measurements, band ankles, and send them on their way.

"It's a whirlwind," says lead bander Ryan Jacob, who has worked these nets since 2009 when he began as a volunteer. "People's memories are terrible," he says, so it's important to have data. And BSBO has a lot: Since 1992 they've banded 225,000 spring migrants—an average of 7,000 annually.

From those data the station has detailed a wave theory of avian migration. Each wave has a unique cast of characters that share ecological traits, such as wintering grounds and diet. And within each are two smaller peaks divided by sex: Males tend to migrate ahead of females to claim nesting territories.

EACH WAVE HAS A UNIQUE CAST OF CHARACTERS THAT SHARE ECOLOGICAL TRAITS.

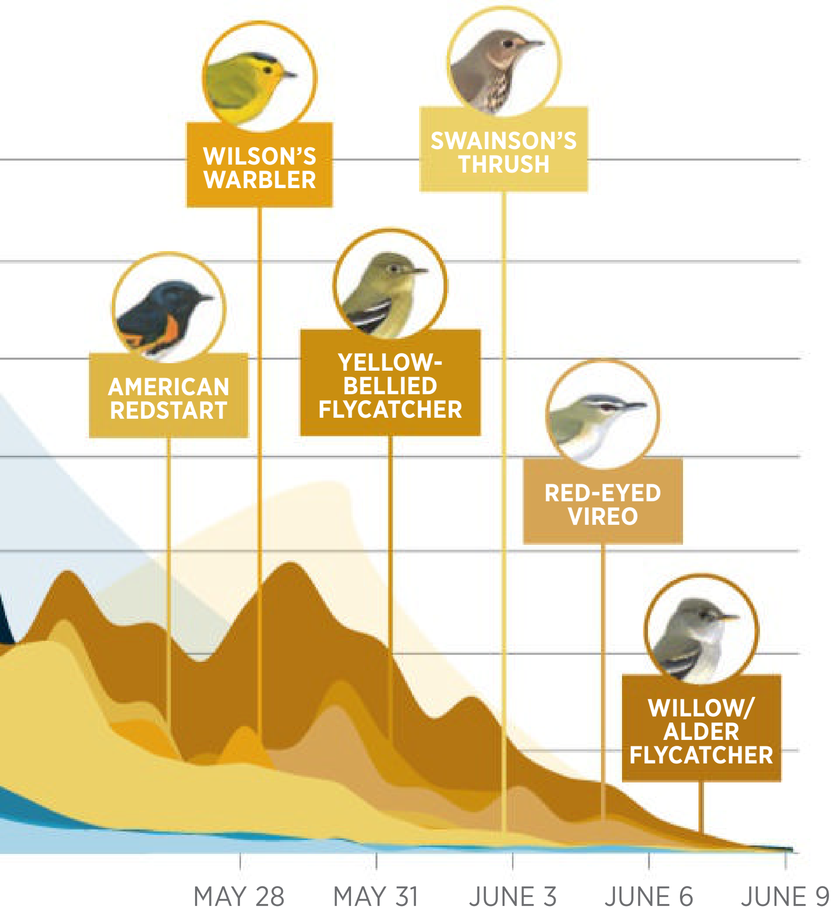
The birds' arrival dates and precise order vary annually. Wind patterns shift. Weather, like storms or late freezes, can interrupt migration, whereas warm breezes and clear skies hasten birds along. Habitat changes on wintering grounds or stopover sites alter routes. But overall, the waves are reliable.

That's helpful for banders, who must carefully plan to process sometimes 600 birds in a single day. "Our number-one priority is bird safety," Jacob says. "Wave theory helps us predict when the big pushes of birds are going to come." It's helpful for birders, too: By knowing what birds to expect they can better prepare for a day in the field. "It doesn't take away from the magic of it," Jacob says. "It's reassuring to know: They're going to be here, and I know when they're going to be here." —*Hannah Waters*

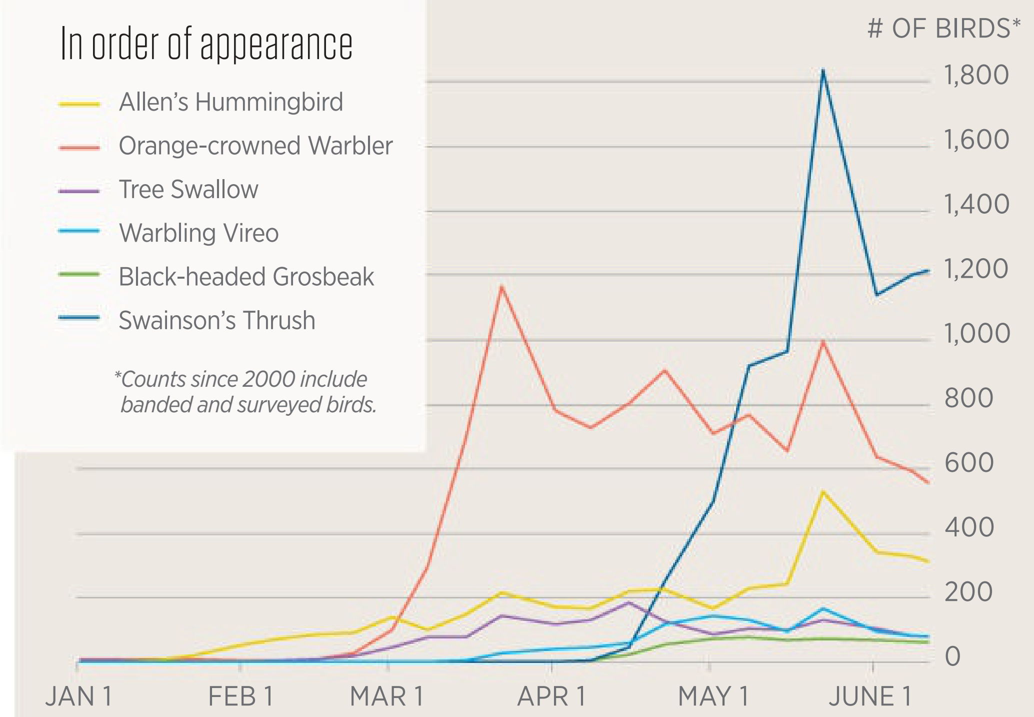
WAVE 3

Bug Lovers

The third wave doesn't come until spring is in full force. Leaves are out, the weather is warm, and there are plenty of bugs. That's when avian insectivores skilled at catching midair insects show up: flycatchers and certain warblers. Caterpillars are also abundant, supporting vireos and cuckoos.



Does the West Coast Experience Waves?



SONGBIRD MIGRATION LOOKS different in the West. So say data from California's Palomarin Field Station, operated since 1966 by the nonprofit Point Blue Conservation Science. The banding station, which records some 3,000 birds a year, is situated on the coast just north of San Francisco specifically to study songbird migration: Many species follow the shoreline as they travel north from wintering grounds.

As early as January, plants start greening, and birders begin hearing Allen's Hummingbird's distinct wing whistle. But it's not a starting bell for a massive influx of birds, as in Ohio. Here, spring migrants arrive in two distinct bursts, says avian ecologist Mark Dettling, a Palomarin banding supervisor. In mid-March bug catchers, such as Tree Swallow and Orange-crowned Warbler, arrive for the insect hatch. Then, in mid-April, berry and seed eaters, such as Black-headed Grosbeak and Swainson's Thrush, make an entrance.

The data don't form wave "peaks," however, because most of the birds aren't visiting for a brief stopover. Some move on to nest farther north. But many stick around and breed near the station. "It's an elongated experience," Dettling says. After a few months, those birds depart and are replaced by species escaping the northern winter. "We get this turnover in species. It's not like where I grew up in Michigan, where you get several months where there is a paucity," Dettling says. "It's lovely for us." *—H.W.*

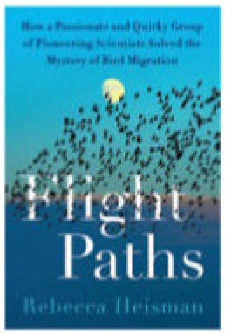
BOOK REVIEW

Harnessing Obsession

How birders pieced together the science of migration

IN THE 1680s, WHEN philosopher Charles Morton sat down to figure out where birds overwinter, he made a guess so off-base that it's still the butt of jokes today: the moon. How ornithologists and birders puzzled together the barely less outlandish story of migration is the subject of *Flight Paths* (HarperCollins, $30, 288 pages) by Rebecca Heisman, an *Audubon* contributor. Its focus is less on the journeys themselves—although Heisman has a knack for capturing the miracles of scale involved—than on the ingenuity it takes to map them.

The book builds toward the cutting-edge tools of migration science, like weather radar, featherweight trackers, and genetics. But it delights in the homespun practicality of research: a needlepointing scientist who sewed harnesses for warblers; a researcher who watches night fliers cross the full moon from a lawn chair; or a crew who chased a Swainson's Thrush for seven nights "in a converted Chevy station wagon with a large antenna poking out of a hole in the roof."


How a Passionate and Quirky Group of Pioneering Scientists Solved the Mystery of Bird Migration
Flight Paths
Rebecca Heisman

The history of migration research, as Heisman tells it, often builds on the work of dedicated amateurs. In those low-tech efforts, it becomes clear that the line between scientist and clever bird lover is almost nonexistent. *—Philip Kiefer*

GRAPHS: JULIE ROSSMAN/AUDUBON. ILLUSTRATIONS: DAVID ALLEN SIBLEY

200 wild parrots now live on the island, and with Lugo, I had the privilege of seeing some at Río Abajo State Forest.

When we arrive, ethereal light is filtering through the trees like a nature-made cathedral. We're power-walking down a cracked asphalt road, on a mission to find the parrots before night descends, when Lugo suddenly stops. A flutter of wings behind us indicates that we just missed a parrot. We backtrack and stand, frozen and waiting. "They're never alone," Lugo says.

Sure enough, a second Puerto Rican Parrot bursts from the forest and perches atop a tree. For a good 30 seconds it stays there, silhouetted against the golden evening light and vocalizing in trios of high-pitched squawks. Admittedly, it's not the most beautiful of calls. But a feeling of awe washes over me as I realize how close this loudmouthed bird, which numbered just 13 wild individuals in 1975, came to disappearing.

After Maria, private donors helped get the parrot program back in the air by providing funds to pay for things like new cages and cameras for monitoring the birds. Similar aid has helped pull other Caribbean islands out of the financial hole left in the wake of storms. When Maria seriously damaged the offices of Dominica's wildlife department, BirdsCaribbean helped organize donations of computers and other equipment. Sending funds or supplies to support unemployed local guides can also be of service. After Maria, for example, Wildside Nature Tours gave Lugo a generator, allowing him to restore power to his home. "Anything speeding the return of tourists can help small island economies recover," Wunderle says.

"HEY, YOUR OTHER LEFT! YOUR GPS is broken!" a tour guide calls out, trying to corral a group of kayakers as they paddle into mangroves, spin in circles, and ram into one another like they're playing a game of aquatic bumper cars. I'm in Fajardo, at the eastern end of the island, to see Laguna Grande, one of Puerto Rico's three famed bioluminescent bodies of water.

Aside from the antics of the novice kayakers, it's smooth sailing tonight under a bright moon. But this isn't always the case. Misael Cruz Rivera, the lead guide at the kayak company, Eco Action Tours, tells me that annual outbreaks of sargassum seaweed—driven in part by warming ocean temperatures—have started to clog waterways here in the summer, smothering wildlife and snuffing out tourism. Cruz Rivera recalls what happened last summer: "All the seaweed stopped the entrance to the lagoon, and that's how she breathes. We started to see fish floating and dying."

The lagoon is vital for many people living nearby. "It supports their families," Cruz Rivera says. So when the seaweed struck, tour guides and locals banded together to painstakingly clear the lagoon, and a group of tourists from Jamaica and elsewhere even pitched in. "They were on vacation, and they just wanted to help us," Cruz Rivera says.

For now such scrappy problem solving is assisting Puerto Rico's nature, and the tourism and livelihoods it supports. But as climate-related stressors build, the future looks more uncertain. It's not just smelly seaweed that's proliferating or hurricanes that are becoming more intense and frequent. Sea level around the island could rise up to three feet by the end of the century. Drought is also a growing concern; in 2015 Puerto Rico suffered a crippling dry spell, killing and stressing wildlife and spurring water rationing for people. "We're talking about ecosystems that are very adapted to disturbance," Fidalgo De Souza says. But if habitats continue to be pummeled without having the chance to recover, "then we have a big problem that could make the ecosystem collapse."

Puerto Rico is a microcosm of problems happening across the globe. Last year alone saw severe flooding in Pakistan, India, South Africa, Nigeria, Afghanistan, and Brazil; drought in East Africa; and a deadly tropical storm in the Philippines—not to mention the now usual spate of extreme wildfires in the western United States and an assortment of less deadly disasters around the world. For many of these places, the return of tourism has been, or will be, an essential component in their recovery. As climate-driven disasters become ubiquitous and inescapable, Ramkumar would like to see the global travel industry take a more direct hand in funneling tourists to affected areas to help with that process. Large travel companies and booking platforms, for example, could create "recovery tourism" packages. "It would have a phenomenal effect," he says.

For now, though, it's up to individual travelers to decide when and how to visit such places, and for the people living there to cope as best they can. Most Puerto Ricans I spoke to said they would deal with future challenges as they come. Ada Ramona Miranda Alvarado, the owner of Hacienda Las Malcriá, a bucolic hillside coffee plantation overlooking a lake, embodies this spirit. A former teacher who also has training in solar panel installation, recycling, bird identification, and regenerative tourism, Miranda Alvarado feels her whole life has led up to growing coffee. "I love to protect my island, and I love to protect everything that's concerned with the environment," she says. Coffee, she's discovered, perfectly melds these passions.

Miranda Alvarado—whom Casa Grande Mountain Retreat recommended I visit—started her plantation in 2019, after Maria, from scratch, learning from her coffee-growing neighbors and through trial and error. Today she has around 1,000 coffee plants interspersed through native trees. She planted additional landscaping to attract birds. When I arrive, she is preparing for a Christmas Bird Count group, and she regularly hosts campers. "Mostly, people come here to connect with nature," she says. The dollars they spend and the future visitors they send her way through their glowing reviews support not only her farm, Miranda Alvarado adds, but also her community.

In September, the importance of community came into focus when Fiona took out around 30 percent of her coffee plants. Miranda Alvarado is rebounding from that setback, however, scraping together funds through tourist visits and donations from friends, family, and Puerto Rico's tight-knit network of artisan coffee growers, since she, like other small coffee farmers, receives no government support. In restoring her land, she's not only rebuilding her own small business but also adding resilience against future storms—resilience that will benefit more than just her. Research shows, for instance, that pockets of undamaged or partially damaged coffee plantations can provide important refuges for birds after hurricanes, and with each tourist who swings by, Miranda Alvarado's neighbors benefit as well in the meals, drinks, and craftworks they buy.

Despite the bumps, Miranda Alvarado still considers the farm to be her "happy place": "It's a regenerative place, not only for me, but also my family, friends, visitors, and our environment." Over a cup of the most delicately flavored coffee I've ever had, made with beans Miranda Alvarado harvested and roasted a few days before, she explains that she chooses not to worry about the future. "Hurricanes will have an impact," she says, shrugging and smiling. "But I just love each day at a time." Ⓐ

Journalist and author **RACHEL NUWER** *lives in Brooklyn and regularly contributes to* The New York Times, National Geographic, *and more.* **ERIKA P. RODRÍGUEZ** *is a Puerto Rican documentary photographer based in San Juan.*

AUWO Continued from page 47

The joyful moment when Doka sees Auwo, captured on a camera he deployed only days earlier, is documented by Jordan.

VIDEO STILL: JORDAN BOERSMA

where she transformed into a bird. Now, when people hear the pheasant pigeon's call, they say, that's Auwo, crying because she misses her home.

What does it mean for a species to be found? I believe knowing the pheasant pigeon survives on Fergusson isn't enough to ensure its future. When Jonathan spoke of Auwo, concern darkened his face. He had already signed over timber rights in the area we visited, Auwo's home, to a logging company. His clan's land is rich with Klinki pine, which Augustin associates with Auwo and which Elimo says is in high demand.

Separated from town, Jonathan's people have almost no access to the cash economy or to necessities like medicine. "What is it you would have me do?" he asked. Serena says population growth is another pressure: "The good gardening areas will be used up; the fallow period will be short. People will travel longer distance for gardening, hunting, and collecting building materials. The habitats of many animals will be lost." Fergusson's hunters also confirmed the presence of feral cats, which are unlikely to bring anything but death to the area's ecosystems.

There's so much we don't know about Auwo, including, crucially, whether sightings are rare because of its dwindling numbers or because human activity causes it to retreat to more remote areas. Elimo thinks both are likely. Only a handful of islanders we interviewed recognize it at all: "Only the old men know about Auwo; the young generation, no, they don't know about it," a hunter named Gerald tells me on a trail. Elimo's father, Fred, notes that cultural preservation and conservation are deeply tied on Fergusson; clans have plant and animal totems that guide how they interact with their environment. During our trip, I noticed Elimo writing Jerome's chant in his notebook. "I felt sad about the legend and the songs," he says. "The next generation, my generation, will not know about these because of changes to society."

Launch a boat from Fergusson and other species across the southwest Pacific await documentation. Throughout this region, ever more mining and logging agreements are being signed, providing neglected and hard-to-reach communities with access to needed resources and jobs. If we don't support the area's Indigenous people and bring them the vital social and economic inclusion they deserve, the forests and biodiversity they harbor don't stand a chance, says West, the anthropologist. "There's no reason that an IUCN listed species can't drive a radically ethical conservation intervention," she says, "but it has to engage with what is needed socially."

In the hubbub of our return from Papua New Guinea, our team pivots to planning another trip. Elimo texts me updates, strategizing how additional interviews could reveal where else Auwo lives on Fergusson and, vitally, how many birds remain. Serena and I discuss how to improve the impact of our next expedition. We had hired more than 150 locals—porters, guides, boat captains, and cooks—during our trip. This time she recommends we also direct funds to communities, where they have a better chance to benefit women, and involve Fergusson's youth more directly in field work.

Documenting a species is often the first step to protecting it, and in that way, I believe scientific expeditions and initiatives like the Search for Lost Birds can help stave off impending extinctions, especially on islands. Beyond our small project, however, I can't say what the future holds for the Black-naped Pheasant Pigeon. Western interest in a species can provide opportunity in this region, but it can also bring pitfalls. Paige West has found that international conservation projects have frequently failed in Papua New Guinea, in part because they've not properly engaged with the very people who have the biggest stake in, and knowledge of, local ecology. Biodiversity and human systems, she says, are intimately intertwined.

What's clearer to me than ever is that any future research we do in this country must continue to include locals from the ground up and grow from there. Conservation decisions are already, and must remain, solely in the hands of Fergusson's communities, without whom we'd never have found Auwo. From listening to hunters, I know we've only scratched the surface of learning about the forest and its birds. It's my hope that this knowledge, stemming from people's use of their forests, will help keep Auwo—now thought to be New Guinea's most endangered terrestrial bird species—from going extinct.

As birds on this planet disappear, Auwo will forever guide my compass toward hope and the beauty we still walk with in our teetering, complicated world. What began with some dusty specimens and a 19th-century research paper led to a mystery, a name, and a breathing creature, a bird of chants and legends that stalks the forest floor. Though Auwo is no longer human, her song assures us that she's still there. Ⓐ

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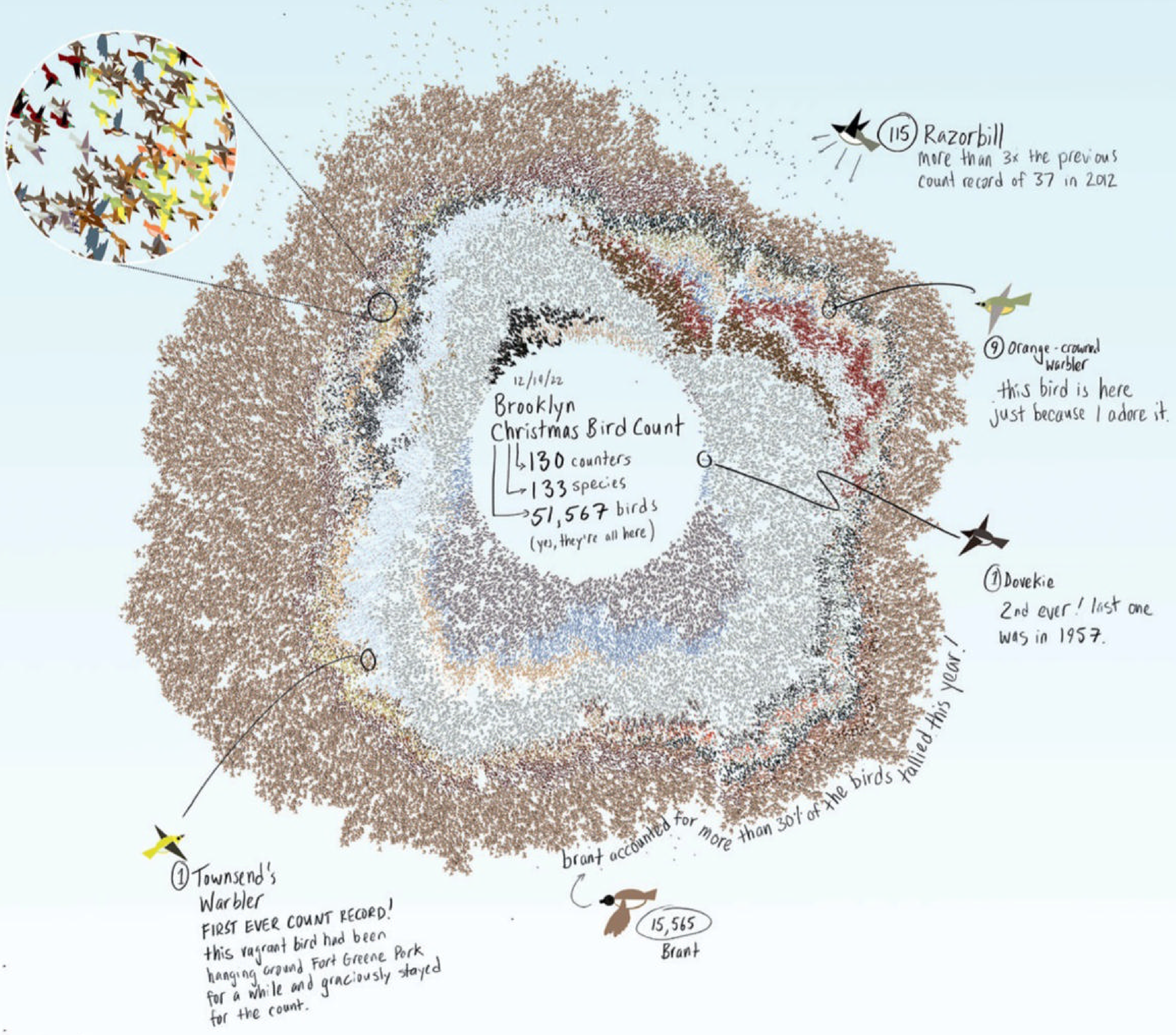
THE AVIARY

Where birds inspire art, awe, and action

EVERY BIRD COUNTS BY JER THORP


12/18/22
Brooklyn Christmas Bird Count
130 counters
133 species
51,567 birds
(yes, they're all here)
(115) Razorbill
more than 3x the previous count record of 37 in 2012
(9) Orange-crowned Warbler
this bird is here just because I adore it.
(1) Dovekie
2nd ever! last one was in 1957.
brant accounted for more than 30% of the birds tallied this year!
15,565
Brant
(1) Townsend's Warbler
FIRST EVER COUNT RECORD!
this vagrant bird had been hanging around Fort Greene Park for a while and graciously stayed for the count.

Explore other artwork from The Aviary series at **audubon.org/the-aviary**.

AFTER MONTHS OF SOLITARY BIRDWATCHING EARLY IN THE PANDEMIC, ARTIST JER THORP jumped at an invitation to take part in the Christmas Bird Count (CBC), Audubon's century-old annual survey. On a chilly day in December 2020, he and other Brooklyn CBC volunteers tallied nearly 50,000 birds. The number struck him. "What does 50,000 birds look like?" wondered Thorp, who often works with huge data sets. He built a computer program to illustrate that, using the even higher tally from the most recent CBC: 51,567 birds from 133 species. The icons in this vast murmuration correspond to each species' shape and color, which Thorp selected manually after poring over photographs. He fiddled with the code for months until satisfied with the plumpness of duck bellies and the prominence of heron bills, and even tweaked the size and wing position of individual birds to render each data point unique. Thorp's aim is to awaken our appreciation for the creatures themselves. "We tend to see a group of birds, and reduce them to a number in our checklist," he says. "The idea is to take those numbers and unpack them again into these delightful little things a lot of us are really deeply in love with." *—Zoe Grueskin*

> "What does 50,000 birds look like?" Thorp wondered.

DATA COURTESY OF THE BROOKLYN BIRD CLUB

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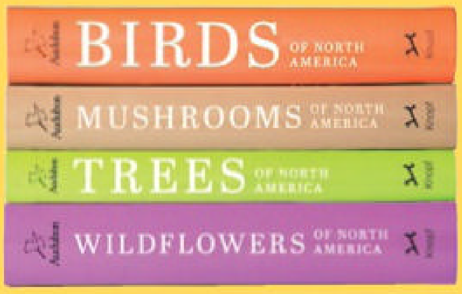
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